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Bethesda, Md.   20084

A REPORT ON THE DEAS PROJECT

(DATA ENTRY ABOARD SHIP)

by

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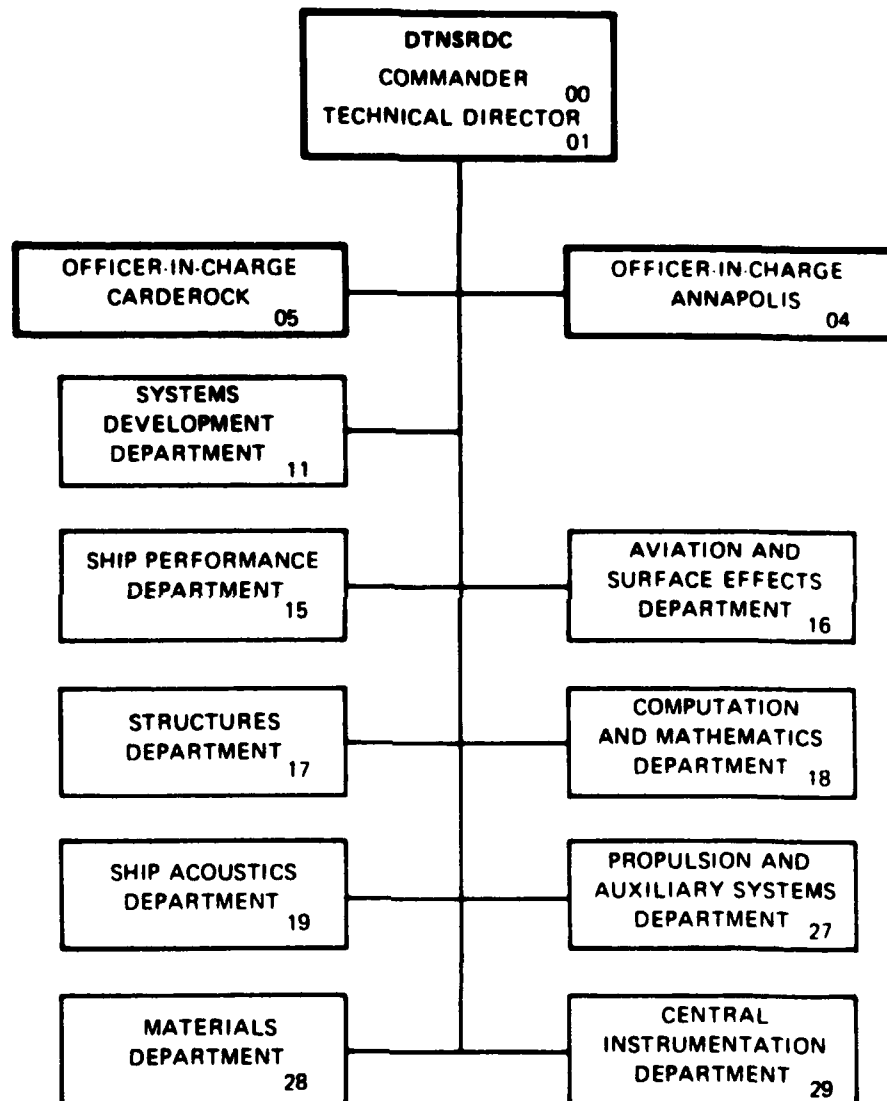H. White
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OCT 14 1976

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COMPUTATION AND MATHEMATICS DEPARTMENT
DEPARTMENTAL REPORT

October 1975   CMD-06-76

MAJOR DTNSRDC ORGANIZATIONAL COMPONENTS

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CMD-06-76	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A Report on the DEAS Project (Data Entry Aboard Ship)		5. TYPE OF REPORT & PERIOD COVERED INTERIM REPORT, 1975. 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R. Koontz, H. White J. Jeffers, B. Siegel A. Camara, M. Zubkoff		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS David W. Taylor Naval Ship R&D Center Bethesda, Maryland 20084		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 62760N TF53531045 1-1867-012
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Supply Systems Command Code 043 Washington, D.C. 20376		12. REPORT DATE October 1975 13. NUMBER OF PAGES 118
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Logistics
Microprocessors
Shipboard data processing
Source data automation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Data Entry Aboard Ship (DEAS) project is investigating the use of microprocessors to provide logistics management automation for the smaller and non-automated classes of Navy surface ships. A breadboard system has been developed and tested in two ship trials. Results achieved and a projection of the concepts needed for an operational implementation of DEAS are covered in this report.

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1. Introduction

1.1 Objectives

The objective of Data Entry Aboard Ship (DEAS) is to introduce automation of logistics functions to those Navy ships where automation has previously not been a practical goal. DEAS will apply modern ADPE and communications technology to the problems of logistics control aboard ships. This objective is to be accomplished by providing a "black box" system (operating under at-sea conditions as well as at dockside) which is functionally and user-oriented. That is, the "black box" system will be driven by canned software packages which will be accessible through functional commands and will be oriented to use by shipboard office personnel (SK's, Engineering Log Room Yeomen, etc.). The entire system will be keyed toward usage requiring a low level of training and requiring essentially no ADP orientation. This type of "enclosed" ADP environment can with current technology be provided through the use of desk-top intelligent terminals.

1.2 Background

The DEAS project had its beginnings in the last quarter of fiscal year 1973. At that time DEAS was initiated as a task under NAVSUP's Material Flow Technology program at NSRDC. In the sixties efforts had begun to provide for automation of logistics functions within the fleet. However, the application of the resulting automated systems was restricted to the large fleet ships (Tenders, Carriers, etc.). The AN/UYK-5 computer (militarized Univac 1500) was introduced into the fleet with software systems for supply (SUADPS) and maintenance. Those systems are still in active use. But the bulk of the

surface fleet (DD, DE, DLG, etc.) were not able to benefit from this initial fleet automation effort. The AN/UYK-5 system is simply too big and complex to be supported on those smaller surface combatants. The constraints of physical space and specialized personnel for on-board ADPE systems have prohibited any real effort to assist the smaller surface combatants until the emergence of intelligent terminal technology in the seventies. Intelligent terminals provide independent CPU computing power in a desk-top package. Recognition of this new technology and its potential capability led NAVSUP to initiate investigation into its potential use as a source of computing power for the Navy's non-automated surface combat ships.

Since the introduction of the AN/UYK-5 and SUADPS, the shipboard logistics control problem within the non-automated fleet, has worsened. Reductions in SMD manning levels have seriously inhibited the ships' ability to comply with standard logistics management procedures and simultaneously satisfy the growing number of outside reporting requirements. In many cases the supply office has been attempting to execute its normal functions with a personnel complement of only 60 percent of the SMD. The impossibility of this situation and its detrimental effects upon shipboard logistics management, morale of the crew and the preparedness of the fleet had become all too obvious. Having long recognized the need for assistance, COMCRUDESLANT in a February 1973 letter to NAVSUP, requested a test program for the use of automated data entry aboard non-automated ships. Subsequently, at the request of NAVSUP, DTNSRDC undertook the DEAS effort to establish whether or not a feasible automated capability could be developed for those smaller, undermanned combatants.

The approach which was selected was to procure an intelligent terminal which would be representative of the state-of-the-art and then to develop a breadboard system which would illustrate the techniques for automating the primary shipboard supply functions. The intent was to test this breadboard under actual shipboard conditions and to evaluate its use by crew members within the appropriate offices. The concept of giving crew members hands-on experience with the breadboard in order to evaluate the feasibility of the DEAS concepts is of major significance and is a significant departure from normal ADPE development practices.

Of equal importance to DEAS has been the concept of fleet involvement. The involvement and cooperation of the fleet has been seen as the keystone to a successful DEAS implementation. Therefore, from the outset of the program there has been continual contact with CRUDESLANT and its successor SURFLANT. In fact, those organizations and fleet personnel have been utilized as a major source of information and direction for the DEAS project.

1.3 Scope

The DEAS project concentrated, initially, on shipboard supply office problems because it was sponsored by NAVSUP. The breadboard system therefore relates to supply functions. However, early in the development of DEAS, a great deal of interest was demonstrated by others outside the supply environment who also had responsibility for data control problems aboard ship. Eventually it became necessary to expand the DEAS concept to include a capability to automate functions for both the maintenance and administrative offices. The breadboard system, however, remained primarily a supply system

although the design concepts embodied in it were equally applicable across the three shipboard management control areas. Although it was not strictly necessary in order to demonstrate the design capabilities of intelligent terminals, the breadboard was expanded to include some selected maintenance applications to provide visibility for maintenance functions within DEAS.

The DEAS concept as it has evolved now uses one to three intelligent terminals aboard each ship, depending upon the size of the ship, to perform the supply, maintenance, and administrative functions.

In addition to DEAS's stand-alone capability a very important feature is the proposal to transmit data directly from ship-to-shore when possible and feasible. Consequently, a study is being undertaken to determine the volumes and types of logistics traffic generated by ships and to investigate the compatibility of available communications procedures with projected DEAS capabilities.

1.4 Methodology

1.4.1 Personnel Contacted

Many personnel were contacted in the formulative stages of DEAS for the purposes of describing current afloat operational procedures and guidelines and for constructive criticism of the DEAS project, especially in regard to the implementation of the breadboard system. The following list contains the names of personnel who provided the DEAS technical team with much of the shipboard organizational and operational information upon which the design of the DEAS system was based. Also included are personnel with ADP experience in management information systems whose critique was indispensable to the implementation of the breadboard system. Note that the organizations and military ranks listed were those at the time of initial contacts.

COMCRUDESLANT

    Lt. Souza (Type Commander)
    SKCM Rayman

SURFLANT

    Cdr. Corbitt
    Cdr. Ryan (3M Action Officer)
    Lt. Cdr. Kowalski
    Lt. Quigley
    SKCM Wolfinger
    Chief Crance

FAGLANT

    Lt. Cdr. Soares
    Mr. Mefford
    Lt. Haas
    Lt. Rose
    SKCM Lindgren

NAVSUP

    Lt. Cdr. Peters
    Mr. Webster
    Mr. Shurick
    SKCM Thacker

U.S.S. ALBANY

    Lt. Cdr. Haase (Supply Officer)
    WO3 Clark
    SK2 Kelly
    SKSN Plater

U.S.S. MULLINNIX

    Lt. Triplett (Supply Officer)
    SKC Pellom
    SK3 Jones

3M COMPANY

    Mr. Chapman

1.4.2 Materials Studies

The following materials were studied and used as reference in designing the proposed DEAS system and in implementing the DEAS breadboard system:

- Afloat Supply Procedures
  NAVSUP P-485

- Afloat Optar Record Keeper's Guide
  NAVSO P-3073

- Ship's 3M Manual
  OPNAVINST 4790.4

- 3-M IMMS/TYCOM Conversion Procedures
  NAVCOSSACT Document Number 89L004 TR-01

- ADP Operators Manual for IMMS
  NAVMACLANT (October 1974)

- Shipboard Uniform Automated Data Processing
  System -- End Use Support Procedures
  NAVSUP P-518

- SUADPS-EU Executive Handbook for CVA's/
  CVS's/LPH's/MAG's
  NAVSUP P-480

- Issues Involved in Implementing a Data
  Processing System on a Minicomputer
  (describes the experimental system aboard the
  U.S.S. DAHLGREN) by Ronald Barry Freeman, 1974.
  Wharton School of University of Pennsylvania

- System Engineering Services for the B-700
  Information Retrieval System for SMMIS
  Aboard HMCS HURON
  Bunker Ramo Document No. Q0052-48
  Revised December 1974

- COMCRUDESPAC ltr FF1-1 4790 ser 43/385
  of 14 Feb 1974

1.4.3 Premises/Areas of Difficulty

1.4.3.1 Assumptions

The objective of DEAS is to introduce automation of logistics functions to those Navy ships where hithertofore automation has not been a practical goal. The manual record keeping procedures of the supply, maintenance, and personnel offices are inherently subject to error, require continual checking, are overly consuming of personnel resources, and are not as effective as they could be with appropriate application of current data processing technology. Essentially, DEAS has been designed, and a breadboard system has been implemented, with the goals of alleviating many of the clerical burdens and data collection functions performed by ships' personnel while, at the same time, satisfying the ships' own local reporting and inventory needs. These goals have been achieved even while operating under the constraints that the system produced must not require an upgrading of the ship's manning skill levels or billets and that it must stay within the existing afloat regulations and guidelines framework.

There were few basic assumptions adopted at the onset of the DEAS project. However, those which were adopted exerted a critical influence upon the development of the DEAS concepts. Those assumptions fell into two areas: (1) the type of environment (vis-a-vis personnel) which would exist aboard ship and primarily in the supply department since that was our initial area of concern, and (2) the type of ADPE system environment which would be feasible aboard smalier combat ships. The assumptions relating to the shipboard supply office were as follows: (1) the typical supply office contains some trained storekeepers with knowledge of supply forms, files and operating procedures,

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(2) the supply Chief Petty Officer and Supply Officer have an in-depth working knowledge of all supply procedures, (3) the supply office follows standard Navy supply regulations, and (4) the typical supply office aboard smaller ships does not need the same complexity of automated support as exists on the large, automated ships.

The significant assumptions with respect to the type of ADPE system to be developed were as follows:

1) SUADPS encompasses a much larger and more complex system of programs and reports than is needed in the typical supply office aboard smaller ships, therefore, the DEAS system would be derived more from analysis of small ship operations than from a condensation of SUADPS applications.

2) A support staff of specialized ADP technicians and supply corps personnel, such as is required by SUADPS, would not be available to smaller ships, therefore, the DEAS system would have to be oriented toward operation by non-ADP supply personnel available under current conditions.

3) In order to minimize problems of implementation and training of personnel, DEAS would have to maintain approximately the same manual interfaces now in existence within the shipboard supply departments.

4) The DEAS system should relieve personnel of as many clerical burdens as possible in order to free up time to perform more critical local control functions which were not getting done.

5) DEAS, the concepts and the breadboard, would have to be developed in evolutionary steps to insure that a proper analysis of the shipboard problems was conducted.

1.4.3.2 Difficulties Encountered

The most basic problem encountered in the development of DEAS was some initial resistance to shipboard automation by CRUDESLANT personnel assigned to assist with the project. This resistance was not, however, based on a lack of interest in or a desire for automation. The resistance was based on doubts as

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to the feasibility of automating a complicated supply and inventory system at the destroyer level. The resistance centered on the level of automation and was based upon their knowledge of the sophistication and complexity of the existing afloat system, SUADPS. The supply personnel recognized that SUADPS encompasses a much larger and more complex system of programs and reports than is needed in a typical supply office aboard smaller ships. Furthermore, they recognized that the staff of specialized ADP technicians and supply corps personnel required to operate SUADPS would not be available to smaller ships. Therefore, there was great concern that any system developed, if it contained too many functions, would be too complicated for shipboard supply personnel. However, their doubts as to the feasibility of a comprehensive DEAS were overcome due to the fact that DEAS development was based on the following concepts: (1) maintaining the same manual interfaces now in existence within supply departments aboard ship, (2) using an intelligent terminal with keyboard and display screen to provide tutorial interaction and instructions for untrained sailors, and (3) easing many of the clerical burdens within the department and providing managerial reports as problem solving tools.

A significant factor in the development of DEAS was to assure, by working with fleet personnel, the soundness of the analytical effort which would be the foundation of the breadboard development. It was particularly important that our logisticians and systems analysts would understand the problem and devise a truly feasible system concept for that special environment on the non-automated fleet.

At the beginning, the DEAS breadboard development concentrated on providing the supply department with a self-validating data collection function for each of the existing supply forms and a simple supply master file capability.

Continued analysis of shipboard supply department procedures (including helpful critiques from support level personnel) led to the concept of separating SIM from Non-SIM records and combining 1348 outstanding records onto one file with the SIM. The isolation of Non-SIM records which represent a small portion of the supply office activity and the combining of the SIM and 1348 outstanding records were important conceptual developments for the DEAS breadboard system. The DEAS breadboard hardware is limited in terms of file handling and accessibility because it only contains three cassette tape drives. Because of the number of types of data (files) and different types of operations within the supply department, initially it appeared that our tape drive limitation would lead to a cumbersome system inappropriate for non-ADP personnel. However, the analysis of stock record activity (SIM, Non-SIM) and the relationship of 1348 data to stock record availability checking permitted separation and structuring of these data so that the hardware could handle them quite efficiently. The Non-SIM records, with their large number of entries, were stored as a separate file to be accessed only when needed on an exception basis. The SIM and 1348 outstanding files were combined into one cross-referenced file on which each record could be searched and retrieved as if the two files were physically separated. Because of this cross-referenced file structure, the DEAS breadboard system could very closely approximate the normal supply office interplay between these two types of data within normal day-to-day operations. Using these file design concepts tape handling and processing time was reduced to practical levels.

A critical factor in designing a practical breadboard model for shipboard use was to develop a system which would be natural for existing supply department personnel. The development of the DEAS on-line system, based on the file

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structure described above, for daily forms data generation and stock record searching, was our solution. Under the on-line system an SK has essentially only one system configuration set-up (tape mounting) procedure which remains virtually static throughout the entire workday. Within this configuration he can conveniently switch back and forth between data entry and stock availability searching. This operational set-up closely parallels the typical supply department operations -- with one exception. That exception is the immediate posting which is performed by storekeepers to the stock record cards. The breadboard DEAS system could not easily perform on-line updates; therefore all DEAS update functions are performed immediately after forms data is completed for the day. The DEAS file updates usually take 1/2 hour and provide the supply department with updated SIM and 1348 Outstanding files. Also an audit listing is produced containing any reject records and all data changes to the supply department files.

The major significant problem with all DEAS modules was to make them operable by ordinary seamen. Therefore, the concept of tutorial operation was critical and had to be embodied in all aspects of DEAS. The on-line system is the best example of that concept. However, it was equally, if not more, important to build those tutorial features into the DEAS file maintenance functions since they would be, essentially, foreign operations for the store-keeper (more so than any other aspect of DEAS). Our ability to successfully introduce tutorial operation into file maintenance functions was subsequently verified during the two shipboard tests.

Because of the expanding role of DEAS, outside the supply department, it was necessary to add a maintenance module to the DEAS breadboard system as a last minute effort prior to the U.S.S. MULLINNIX ship trial. Due to the limited time available, it also became critical to select an application which would be meaningful but still limited enough to be accomplished in the available time-frame. The final system module contained the following features: (1) automated data entry for the 2-Kilo form and the work center codes, (2) a local CSMP for the ship's work center codes with up-to-date lists of 1348 orders and 1250 issues per 2-Kilo, and (3) on-line access to stock file records.

The prime problem in designing the DEAS breadboard model was to apply a new technology to shipboard management problems without introducing the biases of outmoded methods of automation. Our concern was to develop a concept of tutorial, interaction which reduced the reliance on paper output.

1.4.4 Breadboard DEAS System

The DEAS system was conceived, designed, and has been implemented in a breadboard model as a system for Navy ships not presently automated by the Shipboard Uniform Automated Data Systems (SUADPS). The purpose of the breadboard system was to test the feasibility of using current ADPE equipment (provided in the form of desk-top intelligent terminals) in order to apply modern ADPE technology to the problems of logistics control aboard ships. For the breadboard system, the supply office operations were selected and have been partially implemented as representative of the advantages to be gained aboard ship using the DEAS concept. In addition, a set of maintenance applications has also been incorporated into the DEAS breadboard system. The system, as currently implemented, is not intended to be the final product for an automated afloat logistics system, but simply to demonstrate that the most important supply management functions, much of the mundane clerical jobs, and 3-M data collection can be successfully and beneficially automated on modern, economical hardware.

The DEAS breadboard system includes the following features:

- Source data capture and validation via modern data entry technology
- Telecommunications for data transfer
- An automated inventory control system
- Automated requisitioning, including data display aids which assist the Supply Officer in stock replenishment decision making
- Interactive interrogation of data files
- An automated, local CSMP as an aid to management decision making for shipboard maintenance
- A computer configuration operated by such non-DP specialists as supply clerks and modular in design for quick, easy maintenance.

1.4.4.1 Breadboard System Hardware

The breadboard system utilizes current off-the-shelf components.
Minnesota, Mining and Manufacturing Company (3M) equipment was selected for
the DEAS breadboard system due to: 1) the unique manufacturer's software
programs and 2) the compact size of hardware components. The system has the
following basic configuration: 3M Information Processor (3MIP-contains an
8K processor and terminal, CRT, and 3 cassette tape drives in one unit),
keyboard, printer, communications adapter, data phone set, and card reader.

1.4.4.2 Processing Setup

For maximal efficiency of operations, the DEAS breadboard system is
divided into two basic processing setups: 1) daily processing and 2) file
updates and report generation. The On-Line System handles daily processing,
while the Supply and Maintenance Systems handle updating and reporting.

Three master files are maintained in the breadboard system:

1) 1114 SIM and 1348 Outstanding Master File -
    contains all SIM stock battery records, all
    outstanding requisitions with all associated
    status messages, non-SIM transaction records
    held until the non-SIM update is run, and
    three index tables used to speed up search
    and retrieval times,

2) 1114 Non-SIM Master File - contains all non-SIM
    stock battery records and an index table used
    to speed up search and retrieval times, and

3) Maintenance Master File - contains 2-KILO forms
    for maintenance actions in process, and all
    associated 1250's and 1348's generated by each
    maintenance action.

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1.4.4.3 On-Line System

1.4.4.3.1 Supply Daily Processing System

The on-line system concept combines the supply department's routine
daily activities into one simple, convenient computer setup. It provides
the supply department with an efficient operational system for accomplishing
the normal 8-hour workday tasks of collecting forms data, validating forms,
and record searching. The supply daily processing system contains the
supply data entry (validation) programs and the on-line interrogation program.

Collecting forms data is performed at the source level of creation, that
is, the supply clerk familiar with the information is responsible for entering
the data. The system provides the supply clerk with the following data entry
features:

- blinking cursor identifies current position,
- character and field validation,
- skipping fields which are not required,
- automatic *duplication of fields,*
- skipping back and forth between fields
  to correct errors,
- constant information fill-in where
  possible,
- computed field values,
- optional printing of transactions.

The supply clerk uses the keyboard, as if he were using a typewriter,
to display any needed supply form on the CRT and proceeds to key in the
required data. He can also read in form data from a transferable storage
medium, for instance, punched cards, and review and correct it as the data
is input into the system. The displayed form contains the names of each

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data field with a string of asterisks below each name delineating the size of its data field (see Figure 1).

The following is a list of the supply data form displays available on the DEAS on-line system.

1114 Maintenance Update

1114 Add New Record Update

1114 Delete Record Update

1114 Adjustments to Quantity

1250 Issue Form

1348 Order Form

1348 Status Form (General or Undefined Status)

1348 Status Form (Regular)

1348 Status Form (Procurement)

1348 Status Form (Shipping)

1348-1 Receipt Form

1348 Status Card

As the supply clerk fills out a form, the system validates each field entered. An erroneous entry triggers an audible error signal and, more importantly, 'locks' the keyboard. The clerk cannot proceed until he takes corrective action (depressing the erase key which removes the erroneous entry); any other actions are ignored. The clerk then continues filling out the form. In addition to providing forms validation, the daily processing data entry system controls all tape handling operations with tutorial mounting instructions and complete error protection.

FRAME: P1FAD

DESCRIPTION 1114 AND CONSUMMABLE

CRT IMAGE

```
.....5...10..15...20...25...30...35...40...45...50...55...60...65...70...75...80
                        1114 AND CONSUMABLES
        SNTC      STOCK NO.        SIM N-SIM   ATC        E/R/C
        *         ************     *    *      *          *
URO MRT  COGS      EOI      UI      O-H-Q              PRICE
*   *    **        *        **      ******             ******.**
                                              LIMIT
        LOCATION  BEG MO DEM                HIGH    LOW
        PRIMARY   VMMDD                     ******  ******
        ******    *****
                        SUBSTITUTE DATA
        AI LOW          SSTC  SUB-STOCK NO.        DESCRIPTION
        ******          *     **************       ***********
.....5...10..15...20...25...30...35...40...45...50...55...60...65...70...75...80
```

Figure 1 - Blank 1114 Addition Form

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After a completed form has been visually reviewed, it is written onto a cassette tape containing the day's transactions and it can optionally be printed if hard copy is desired. At the end of the day, all of the day's transactions are processed against the 1114 SIM and 1348 Outstanding master file. Prior to updating, any form on the transaction tape can be recalled, displayed, and modified.

While performing his daily duties of recording supply forms data, the supply clerk can switch back and forth between different form types as often as he desires. In addition, at any time he can call up the on-line inter-active interrogation program in order to locate, display, and optionally print any 1114 stock record and/or any accompanying 1348 outstanding requisitions with status messages. By incorporating this feature into the daily processing system, the breadboard system allows the supply clerk to handle all of his normal workday duties with one computer setup requiring a minimum of tape handling. This procedure provides the supply department with rapid and complete visual information retrieval of its high activity master files, displaying all of the data fields in 1114 stock records, 1348 orders, or status messages.

The on-line interrogation routine allows for retrieval of 1114 stock records (and all associated outstanding requisitions) by NIIN, part number, or local stock number. It also permits the supply department to retrieve any individual 1348 outstanding order and all accompanying status messages by document number. The system tutorially displays instructions for all options available to the supply clerk. Since the SIM and the outstanding

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requisition files are on-line at all times within the daily processing setup, the only time the operator is required to make a tape change is when he wishes to retrieve a non-SIM stock record from one of the non-SIM file tapes. In this case the system tells him exactly which non-SIM file tape (by number) to mount temporarily in place of the transaction tape. The DEAS system completely monitors this entire process, insuring that the proper non-SIM tape is mounted and that following the stock/requisition interrogation session, the day's transaction tape is properly remounted before the storekeeper can proceed to enter more supply forms data.

1.4.4.3.2 Maintenance Daily Processing System

The maintenance daily processing system performs maintenance data entry collection and validation. The sailor filling out a maintenance form (2-KILO) is provided with all of the data entry features and system error monitoring provisions available to the supply clerk who fills out supply forms. Since these features are detailed in section 1.4.4.3.1, they will not be reiterated here. But it is important to stress again the ease of operation afforded the user within these computerized procedures. Errors made by the operator are screened by both the data entry validation features and by the operating system's thorough monitoring of each successive step of the system's execution. The maintenance daily processing system includes the same on-line interrogation program included in the supply system. Using this program, maintenance personnel can access the supply stock battery and outstanding requisition files as an aid in determining the availability of parts required for a maintenance action and in preparing the required 1250 issue requests.

The following is a list of maintenance input forms available within the DEAS breadboard system:

- 2-KILO Maintenance Action (see Figure 2)
- 2-KILO Completion
- 1250 Issue Request

DESCRIPTION 2-KILO FORM (MAINT SYSTEM)

CRT IMAGE

```
        5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
                          SHIP'S MAINTENANCE ACTION FORM (2-KILO)
1  *
2
3  I.        W/C      JSN        AFL/AFL
4            ****     ****       **********
5   SHIP'S NAME      EQUIP NOUN NAME    W/O STA CAS DFR
6   USS MULLINNIX    **************      *   *   *   *
7   HULL NUMBER      IDENT/EQUIP SERIAL NUMBER           EIC
8   DD 944           *************                       *******
9   SH               LOCATION                  DISCOVERED DATE
10  *                ****************************        ****
11  ALTERATIONS                   */**  INSTRV NUMBER  SUFFIX  U  S  P/F
12  *******************                 *******        **      *  *  *
13  II   S/F MHRS EXP    DEFER DATE              I/F MHRS REM    DEADLINE DATE
14       ****            ****                    ****            YR * DAY ***
15  III  ACT TYN    S/F MHRS   COMPL DATE       ACT MAINT   TI   METER READING
16       **         ****       YR * DAY ***     TIME ***         *****
17  IV   CSMP SUMMARY                           PRI          T/A
18  ****************************************     *            *
19  IUC * TYCOM * DIV INIT   DEPT INIT   COMM OFFICER                 TYCOM
20  RMKS/DESCRIPTION                                                  *
        5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
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Figure 2 - Blank 2-KILO Form

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1.4.4.4 Supply System

The supply system accomplishes the functions of ordering, updating, reporting, and data transmission. For ease of explanation it will be presented as a number of subsystems.

1.4.4.4.1 Supply Update System (SIM and Outstanding)

The transaction tape from daily processing and requisition order systems contains 1250 issues, 1114 SIM and Non-SIM record changes, 1348 requisitions and status records, and 1348-1 receipts. These various record types provide the changes, updates, and adjustments to the supply department's files. This transaction data is reformatted and sequenced by stock number (NIIN) and document number prior to input into the Daily Update Program.

The Daily Update Program is responsible for any changes to the 1114 SIM and 1348 Outstanding Master File. The program performs such tasks as: 1) decrement SIM on-hand quantity when a 1250 issue is posted, 2) adjust SIM on-hand quantity from a gain-by-inventory (GBI) or a loss-by-inventory (LBI) entry, 3) change unit price, location or add a substitute NSN, etc., or 4) add or delete any 1114 SIM stock record. Due to the large size of the Non-SIM file, any action to the 1114 Non-SIM stock records is temporarily held on the 1114 SIM and 1348 Outstanding Master File tape until it can be processed by the Non-SIM Update Program against the 1114 Non-SIM Master File. The Daily Update Program also posts 1348 requisitions and status messages to the SIM Master File. When a 1348-1 receipt is entered, the 1348 outstanding requisition is deleted from the master file (provided the receipt is not a partial receipt) and the receipt quantity is added to the 1114 on-hand quantity.

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There are many checks within the program to ensure that accurate data is added to the master file. For instance, a 1250 issue for stock items is an error if the unit of issue does not match the 1114 stock record of issue. This error and other possible erroneous data are listed on the SIM and Outstanding Audit Trail - Reject List. The list is also used as a recorded diary of all update actions and their effects. An updated 1114 SIM and 1348 Outstanding Master File is produced by the Daily Update Program.

1.4.4.4.2 Supply Update System (Non-SIM)

A Non-SIM update is run on an as needed basis, normally either weekly or monthly, depending upon Non-SIM volume. The Non-SIM transactions which are temporarily stored on the 1114 SIM and 1348 Outstanding Master File during the daily updates are inputed into the Non-SIM Update Program in order to produce an updated 1114 Non-SIM Master File. A Non-SIM Audit Trail - Reject List is printed containing a history of all master file updates, changes, and adjustments. As with the SIM and Outstanding Audit Trail - Reject List, the Non-SIM listing contains 1250 issues from stock, changes to data fields, LBI's and GBI's, posted receipt quantities, record additions and deletions, and a list of all possible errors, such as an incorrect unit of issue on a 1250 issue record. After the Non-SIM transactions are processed, all the Non-SIM transactions are purged from the 1114 SIM and 1348 Outstanding Master File.

1.4.4.4.3 Reorder and Master File Listings

In order to present the Supply Department with a concise picture of the
stock battery and also for hard copy back-up in case of temporary hardware
failure, SIM and Non-SIM master file lists are provided. These contain SIM
and Non-SIM records on separate listings, also displaying the number and type
of outstanding orders for each unique stock record. Each stock record is
listed with the identifying fields required for maintaining accurate stock
records which agree with the COSAL, for aiding in stock replenishment
decisions, and for helping with the issue of supplies from stock locations.

A candidate reorder option provides a listing of just those SIM or
Non-SIM records due for reorder and includes for each record the number (and
cost) of items necessary to restore the high level limit.

The candidate reorder list can be used by the Supply Officer, either
separate from or in conjunction with the data displays in the order system
(see 1.4.4.4.4), in order to determine which 1348 requisitions are most
necessary for stock replenishment. The master file and reorder program and
all other supply programs are designed for operation by a supply clerk
completely inexperienced in data processing. An example of the tutorial
interaction between the supply clerk and the computer display instructions
is demonstrated below.

In this example, the supply clerk wants the SIM master file printout
(listing) option. He enters the program identification (CANRO) and
the program is read into memory from the supply program tape. The
following display appears:

VIDEO DISPLAY
            KEY C TO LIST CANDIDATES ONLY,
            KEY A TO LIST STOCK RECORDS.
    (RESPONSE) "A"

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Note: Only the letter "C" or "A" will work, the system will
not continue until either "C" or "A" is keyed in; no
other keys will activate the system.

VIDEO DISPLAY

KEY S FOR SIM REPORT, N FOR NON-SIM

(RESPONSE) "S"

Note: Only the letter "S" or "N" will activate the system.

VIDEO DISPLAY

MOUNT 1114 SIM AND 1348 OUTSTANDING
MASTER FILE ON DRIVE 2.
TURN ON AND SELECT PRINTER.
KEY M WHEN TAPE IS MOUNTED.

The supply clerk mounts the correct tape on Drive 2 and keys
his response.

(RESPONSE) "M"

Note: Mounting the wrong tape gives the following display.

VIDEO DISPLAY

WRONG TAPE ON DRIVE 2.

MOUNT 1114 SIM AND 1348 OUTSTANDING
MASTER FILE ON DRIVE 2.
TURN ON AND SELECT PRINTER.
KEY M WHEN TAPE IS MOUNTED.

(RESPONSE) "M"

At the end of the job, the screen displays the following message.

VIDEO DISPLAY

PROCESSING COMPLETED

The supply clerk can either recycle through this routine,
selecting another option; switch to another routine, or
return to other duties. (A minor improvement to be made to
the above session is for the system to indicate the name and
date of the incorrectly mounted tape.)

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1.4.4.4.4 Automatic 1348 Order System

Requisitions for stock replenishment can be automatically generated using the 1348 Order System. The Supply Officer, or his designated requisitioner, operates the 1348 requisition selection routine to select those 1348's he can order while remaining within the limits of his financial budget.

To initialize the reorder review, the requisitioner is directed to mount the day's transaction tape and the candidate requisition file tape. The system then proceeds to verify the tape headers. The reorder program will provide a screen display of each reorder candidate so the requisitioner can review them and make his reorder decisions. However, the system does permit the requisitioner to limit its selection of candidates to be displayed for review. The limiting selection criteria which are available are as follows: 1) all reorder candidates, 2) only those candidates whose reorder quantity is within a variable parameter designated by the requisitioner, 3) only those candidates whose unit price is within a range designated by the requisitioner, or 4) only those candidates whose extended price falls within a range set by the requisitioner. In addition the reorder program will display a running total price for items which have been selected for reorder. The requisitioner can also set (optionally) an upper limit which is compared to that total price. If the total price limit is reached, the requisitioner must either stop the reorder process or increase the upper limit.

For each item selected for visual review, a completed 1348 form is displayed on the CRT. It contains the field values from the stock battery files, including the quantity needed for reordering to high limit. Fields not on the stock battery files are filled in from a table which contains a default value for each such field (this table can be accessed and changed if desired). The requisitioner can accept or reject the creation of the 1348 as is or he can modify any of the field values on the 1348 and then accept it. Document numbers are automatically assigned to each generated 1348 by the system. Field value changes are accomplished using the full range of DEAS data entry techniques and features (see section 1.4.4.3.1). A hard copy of any requisition can also be optionally printed. The new requisitions created are placed on the daily transaction tape for system updating and for later transmittal to a tender or a Naval Supply Center (see section 1.4.4.4.6 for a description of the transmittal system). It should be noted that requisitions can also be filled out using the 1348 form provided with the On-Line System. That procedure may be used if the number of requisitions to be produced is small and saves the supply personnel from operating the Order System merely to generate a few requisitions.

The Order System is used to create all types of 1348 orders and follow-up messages, not merely replenishment of items at or below reorder point. The other types of 1348 orders which can be produced are:

1) Walk-through 1348 (e.g., SERVMART),

2) CASREPT 1348 - this order produces a MILSTRIP form which is delivered to the ship's communication office,

3) DTO (direct turnover) 1348 - an order designated for a particular department within the ship, and

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4) SR (stock replenishment) 1348 - orders supply items
which will be needed but have not yet
reached reorder point.

The requisitioner is allowed to go back and forth between the different types
of orders as they are produced. The same default field values and DEAS data
entry techniques and features are used in creating these orders as are used
to create requisitions for items at or below reorder point.

1.4.4.4.5 Outstanding Orders and Status Listing

The Outstanding Orders and Status Listing allows the supply department
to review and expedite 1348 requisitions currently in the Naval Supply System.
The list displays all of the ship's 1348's on order and all status messages
received by the ship relating to those 1348's. Using the list, the Supply
Officer can determine which orders need follow-up messages, a change in
priority to ensure delivery, or cancellation. A copy of the status listing
distributed to the ship's work centers is an important added feature of the
DEAS breadboard system. It provides the various work centers with an
up-to-date accounting of action on their outstanding supply requisitions.
The listing can be produced using any of three options: 1) a complete list
by work centers, 2) a list of requisitions and status for a particular
priority, or 3) a list of requisitions and status 30 days or older, or
60 days or older.

Each listing contains the 1348 requisitions and all related status
messages in work center code and document number sequence. All of the data
fields from the standard 1348 Navy form are printed with related status
messages printed directly below each requisition. The following status fields
are printed only when different from the original 1348 requisition information:

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routing identifier, media and status code, stock number, unit of issue, quantity, and document number. For instance, if a substitute stock number is indicated on the status message, it will be printed because it replaces the original 1348 requisition stock number. In all cases, the remainder of the status data (status code, etc.) will be printed.

1.4.4.4.6 Supply Transmittal

An important feature of the DEAS breadboard system is transmittal of 1348 requisitions and 1250 issue data to support activities ashore. This data can be transmitted while the ship is in port over conventional telephone lines. At sea, a transmittal tape containing 1348's and 1250's can be mailed ashore or to tenders until advances in direct communications are provided for non-tactical applications.

The DEAS breadboard system includes two routines which interface with the breadboard system manufacturer's software program for data telecommunication. One, the 1348 transmittal requisition program selects the DTO and SR 1348's for transmission from the daily transaction tape. Whenever a 1348 CASREPT order is encountered, the supply clerk provides MILSTRIP group and date information and a MILSTRIP form is produced. The second program, a 1250 transmittal program, selects all 1250 records from the daily transaction tape and the 1250's are transmitted in the same way that the 1348's are transmitted.

1.4.4.5 Maintenance Update and Report System

A small set of maintenance applications has been incorporated into the DEAS breadboard system. A master file of 2-KILO forms with supporting 1250's and 1348's is maintained using the maintenance transaction tape produced by the maintenance daily processing system. The maintenance system provides a supply tie-in to 2-KILO maintenance jobs through an interface with the supply department files. The system gives the various work centers within the ship a local CSMP printout showing each 2-KILO job, the 1250 issue requests delivered to and completed by the supply department, plus any 1348 requisitions which were created by the supply department in order to fill a 1250 issue request. The maintenance system also produces a maintenance completion report detailing completed maintenance actions. See section 1.4.4.3.2 for additional maintenance system capabilities.

1.4.4.6 Special Techniques

The DEAS breadboard system has been implemented using the principle of tutorial interaction between the system and the user. Care was taken to provide user action prompting displays which were not so lengthy and complicated that user operation is bogged down with trivial user responses or, worse yet, is confused because of the variety of possible alternative actions available at any given point. Erroneous user inputs are immediately signaled to the operator for correction.

One example of the executive type control of operations incorporated into the system is the system's usage of cassette tape headers. Each cassette tape in the system, including blank tapes, has a standard tape header which

contains, among other things, the tape number, the tape name, and the creation date of the tape and a tape usage code used for system tape mount checking. The operator is told precisely which tapes to mount for each action underway. If the wrong tape is mounted, he is told to mount the correct tape and is given the identification of the incorrectly mounted tape. The date of each master file tape mounted is displayed before proceeding with the system processing so that the operator can double check that he is using the latest edition of the appropriate master file. For ease of operation, tape changing is kept to a minimum.

The supply files have been separated into 1) SIM and outstanding requisitions, and 2) Non-SIM so that related data can be stored together as much as possible, while retaining fast retrieval time for on-line file interrogations. SIM and Non-SIM records are placed on separate files because of the massive number of records contained in Non-SIM files and because most activity is against the small SIM file. The outstanding records are placed on the same file as the SIM records so that both SIM and outstanding records can be quickly and easily retrieved. This file is updated daily against all supply input transactions. Non-SIM transactions are stored on this file until such time as it is deemed desirable to update the massive Non-SIM file, thereby saving a tremendous amount of needless operational time in performing Non-SIM updating. Both the SIM and outstanding requisition files are in sequence by stock number. Since the supply department requires access to the outstanding file by document number, a complete index of outstanding file document numbers and their corresponding locations on the SIM and Outstanding file is maintained at the front of the SIM and Outstanding file.

The cassette tapes used in the breadboard system are blocked, which means that if the block number of a particular record on the file is known, it can be accessed directly by advancing the tape (at high speed) directly to the required block and reading only that block. Both master files have a stock number index, listing every sixteenth stock number on the files and their beginning block locations. This procedure permits high speed access by stock number. The SIM and Outstanding file also contains a Non-SIM tape index indicating for each Non-SIM tape the range of stock numbers on it. Because of this feature, the system can tell the operator exactly which Non-SIM file tape to mount during Non-SIM inquiries.

A considerable asset in the breadboard system is provided by the use of the manufacturer's data entry forms generator package. The various input transaction forms contain a comprehensive set of validation features and the user can easily change from one form to another. It was necessary to modify this package so that the on-line system could include the master file interrogation routine (AVAIL). This resulted in an on-line daily system which performs the daily activities of the supply system and requires cassette tape changing only during a Non-SIM file interrogation.

Optional printing of CRT displays has been provided wherever hard copy might be desired. Discreet usage of printing options can save the user much printing and paper.

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The DEAS breadboard system is written in 3MIP assembler language and
contains several small programs for reformatting data and performing simple
functions necessitated by 1) the use of some of the manufacturer's software
programs, 2) the limitation of memory size (8K bytes), (which is compounded
by the 3MIP assembler language's use of both paging and banking techniques
for addressing) and 3) the limitation of three cassette tape drives as the
only storage medium. All programs with the exception of the manufacturer's
data entry generator, SORT/MERGE, and transmittal (ASR 33) programs were
written by DTNSRDC programmer analysts. Most of the programs were written
in less than 4K bytes. Limiting program sizes was actually found to be very
advantageous in that it resulted in better, simpler to change routines with-
out appreciably affecting processing capability at any given point.

1.4.5 Shipboard Test Results

1.4.5.1 U.S.S. ALBANY (23 September 1974 - 15 November 1974)

The DEAS shipboard test aboard the U.S.S. ALBANY was comprised of training, supply data file creations, and operation in parallel with supply department operations. Phase one of the test was to train the two assigned supply personnel to use the DEAS breadboard hardware and create master files containing the consumable records.

Each man was given two 2-hour training sessions to familiarize them with the data entry of forms and the master file search program in the DEAS breadboard system. The training included:

1) How to handle cassette tapes and change printer paper,

2) Load data entry program (Supply Forms) into computer memory,

3) Switch from one data entry program to another,

4) Key in data to complete the displayed supply forms,

5) Learn the validation and correction features for the displayed supply form,

6) Learn to switch to the search program and interpret the displayed data fields of the 1114 Stock Record or the 1348 Requisition and Status Records, and

7) Learn the proper open and close down procedures of the DEAS computer.

After the training sessions the entire consumable stock battery and consumable outstanding file was keyed in to create the 1114 SIM and 1348 Outstanding Master File and the 1114 Non-SIM Master File. A total of 996 records were placed on the master files. A breakdown of the records is

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given in the following list:

1) 1114 SIM Stock Records - Total 382 Records

2) 1114 Non-SIM Stock Records - Total 379 Records

3) 1348 Outstanding File (Requisitions and Status) -
    Total 235 Records.

Data entry times for these records were typically 50 records entered per hour. Entry times of up to 65 records per hour were recorded. These times include printing the form upon completion of entry but exclude such things as major interruptions to perform non-DEAS duties, coffee breaks, and master file updating times.

The next phase of the DEAS test was to run parallel to the supply department manual system. Each sailor spent 10 hours to train and familiarize themselves with all facets of the DEAS system. Included in their training were such points as:

1) Key input of 1250 issues, 1348 requisitions,
    status messages, 1114 SIM and Non-SIM data changes,
    and 1348-1 receipts,

2) Tape changing to provide inputs and outputs required
    by various DEAS programs,

3) Creating new daily master files and storing
    yesterday's master files,

4) Performing all functions of program selection,
    updating master files, and generating reports,

5) Studying the audit trail-reject lists to check the
    accuracy of inputs to master file updates, and finally,

6) Producing reports to determine reorder quantity,
    latest status and progress of outstanding requisitions,
    and data field maintenance required for stock records.

Following the 10-hour training period, the supply personnel were operating the DEAS system parallel to the manual system.

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The assigned supply personnel worked two hours each day to run the DEAS hardware and performed supply data maintenance and forms creation. Manual forms which related to the DEAS test files were tagged during daily manual processing and later entered into the DEAS system. After key entry of daily supply transactions (1250 issues, loss by inventory, gain by inventory, 1348 requisitions, etc.) the 1114 SIM and 1348 outstanding file was updated each afternoon. The audit trail was produced by the master file update program. The listing was examined by the supply clerks to check the accuracy of the update action. If an error occurred on the audit trail, corrective action was taken.

Every two or three days these actions occurred:

1) The 1114 Non-SIM file was updated and the Non-SIM audit trail was checked,

2) Candidate reorder lists were produced for both the SIM and Non-SIM files,

3) A listing of 1348 outstanding orders and status was printed for the ship's departments,

4) A complete listing of stock records was printed to keep current information on all 1114 records accessible for review and for test monitoring.

In addition, one batch (fifty 1348 requisitions) was successfully transmitted to and received back from the DTNSRDC shore computer in Bethesda, Maryland via voice grade telephone lines.

A review of the ship's manual system pointed out the following problem areas in the ship's records:

1) A typical survey of the 1114 stock battery showed approximately 13 percent of SIM and 6-1/2 percent of Non-SIM records were below reorder point and not on order. This indicates that 1250 issues were posted correctly, but that there was no time for 1348 orders for stock replenishment to be produced.

2) Another survey indicated that up to 40 percent of the SIM records contain incorrect high and low limits and a smaller percent of other incorrect data, such as an outdated unit price. Many Non-SIM records also contained inaccurate data fields.

3) A review of the 1348 outstanding file indicated frequent errors in the 1348 requisision released by the ship for ordering supplies. Data fields repeatedly incorrect were unit of issue and unit price. Other data fields in error included fund code, NSN, etc.

4) There were frequent problems in locating 1348 orders listed on the 1114 stock record. That is, it was sometimes difficult to determine whether a stock item was ordered or if, in fact, the ordered stock item had already been received. The 1348 order listed should have been in the 1348 outstanding file, but sometimes it was found in the 1348 completed file and not so indicated on the 1114 stock record.

5) Another problem in locating order information was that some of the orders were out-of-sequence in the 1348 outstanding file and the 1348 completed file.

The DEAS system was well received by the personnel in the supply office. Their critique was positive, their only complaints being that the financial portion of the supply system was not yet automated in the breadboard system and that the system was not placed on board permanently. The tutorial approach designed into the system software allowed the personnel to learn the entire system in a very short time (14 hours). In fact, training was accomplished at a rate exceeding expectations. Changes recommended by the supply personnel were easily incorporated into the system.

1.4.5.2 U.S.S. MULLINNIX (1 April 1975 - 12 May 1975)

This DEAS shipboard test was comprised of training, data file creations, and operation in parallel with actual ship's work. Ship personnel were trained on an as available schedule. Training for each person was two 2-hour periods for the data entry portion of the system and a total of 10 hours for the update and report generation portions of the system. Actual ship's transactions were entered and processed during the training periods for maximum usage of the personnel. Seven supply department enlisted personnel were utilized in this test. Two were trained to use the entire system. The other five were trained in the data entry portion of the system. In addition, four non-supply enlisted personnel were trained to operate the equipment using a set of manufacturer supplied games programs. None of the personnel experienced any difficulty in learning to use the system. All of them were able to load a cassette program tape, initiate programs, and run programs by following the directions given on the CRT after two or three minutes training. Supply personnel easily adapted to the DEAS automated supply system. Even new supply personnel, with little or no previous shipboard experience in supply, quickly learned to understand and use the DEAS supply system. In fact, given the naturally hectic training schedule of new supply personnel in the busy, "fire-drill" atmosphere of the ship's supply office the automated system was found to be an efficient and effective aid for on the job training of new personnel into viable working members of the ship's supply department.

Data entry of a typical form was accomplished at an average rate of one
every two minutes. Additional processing for updating, error correction, and
report generations averaged one minute per form. During the DEAS shipboard
test aboard the U.S.S. ALBANY in the Fall of 1974, it was found that an
operator can comfortably enter and print one form a minute. Two of the general
reasons for the slower rate during this test are listed below (some specific
reasons are detailed later).

1. The personnel were invariably interrupted to perform other
    duties. A breakdown of the operator's time into DEAS and
    ship's operational duties during a DEAS utilization session
    was not attempted. In addition, measurements of interruptions
    unconnected with either were not broken out.

2. In order to obtain the representative record collections
    contained in the Outstanding and Maintenance files, the operator
    was required to find, pull, input, and then replace records
    from ship's files. Since the records were not consecutive, this
    consumed a good deal of time, which was not separated out of
    the data entry times recorded.

The data entry times could have been significantly decreased by not requiring
the printing of each input form. They were printed for monitoring and docu-
mentation purposes of the DTNSRDC personnel.

The first task of the test, constructing the DEAS data bases, was largely
accomplished by the third week to allow processing supply transactions as they
occurred within the supply office. The logistics information developed into
data bases was: 1) 1114 SIM stock records, 2) 1114 Non-SIM stock records,

3) Outstanding File information (1348 Requisitions and Status Messages inputed by card reader), and 4) 3-M master file information (2-Kilo jobs, 1250 issues and 1348 requisitions).

The second task was to operate all modules of the DEAS system as part of the ship's daily routine. Both supply department personnel and DTNSRDC personnel operated the DEAS system on a daily basis -- depending on the availability of ship's personnel. The functions performed during the shipboard test are divided into daily functions and periodic functions.

Daily Functions: The system functions performed on a daily basis were continually executed by shipboard and DTNSRDC personnel. These daily functions are further subdivided below.

a. Input (data entry) of logistics data -- the capture of data for local file updating. The following types of data were captured as they occurred each day.

   - 1250 issues
   - 1348 requisitions
   - status messages
   - 1348-1 receipts
   - 2-Kilo forms
   - 1114 transactions

b. File information searching -- answering stock battery and status requests on a walk-in basis using the automated system.

   - stock availability and location
   - outstanding status

c. Daily reports -- these reports were generated on a daily basis using DEAS, usually at the end of the workday.

   - audit trail list (SIM's, requisitions, issues, etc.)
   - SIM stock battery list

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d. File maintenance -- at the end of each workday the following
files were updated with the day's transactions.

- Sim stock battery file
- Outstanding file

Periodic Functions: In addition to functions which were performed daily,
other functions were executed on a three or four day basis.

a. Periodic reports -- the following reports were generated at
the end of each three or four day period.

- Non-SIM audit trail
- Non-SIM stock battery list
- Candidate reorder list (SIM and Non-SIM)
- Outstanding requisition status list
- Local ship's CSMP
- Local ship's completed maintenance jobs

b. File maintenance

- 3-M master file
- Outstanding requisition and status file
- Non-SIM stock battery file

c. Special function -- a DEAS function which did not correspond to
any current procedure was the Automatic Requisition Reorder
Selection. This feature allowed the supply officer to select
items for reorder; the system then generated an automated
1348 requisition form.

At the conclusion of the test aboard the U.S.S. MULLINNIX, the DEAS project accomplished its primary goals for this test. The ship's Captain, Commander Clardy, was highly complimentary of the local ship's CSMP and its utility. The supply department head, Lieutenant Triplett, was using the DEAS generated reports to research problem areas in the supply office files. Chief Petty Officer Pellom complimented the efficiency and accuracy of the DEAS system, and SK-3 Jones enjoyed operating the DEAS computer.

Basically, the DEAS programs and procedures were utilized as a direct replacement for existing manual procedures. The supply personnel adapted readily to running the DEAS tutorial programs (14 hours training, as compared to weeks of training to run a larger computer), and the supply clerks were proficient in interpreting all the information produced by the DEAS system.

The DEAS breadboard equipment performed exceptionally well during the 6-week test. At-sea conditions provided the DEAS equipment with a true test of the various vibrations (firing 5-inch guns), stress and pressures (sharp turns, heavy rolls), power fluctuations, and hard knocks (18-20 foot seas) many Navy ships encounter. In fact, the computer equipment responded so well that the manufacturer's maintenance technician accompanying the DTNSRDC research personnel was off-loaded and sent home on the seventh day of a 13-day voyage. A concluding comment on the DEAS breadboard equipment is simply -- there were no malfunctions.

FILE GENERATION AND TRANSACTION PROCESSING SCHEDULE

Inclusive Dates	Accomplishments
2 April - 6 April	Create the SIM stock record file containing all of the ship's SIM stock items.
3 April - 8 April	Create a partial maintenance file.
16 April - 26 April	Create an outstanding requisition file containing the ship's high priority outstanding requisitions (Pri 2-9) and all outstanding requisitions for SIM items.
27 April - 7 May	Add a representative portion of the status messages in the ship's file to the outstanding requisition file.
1 May - 2 May	Create a representative Non-SIM stock record file.
5 May - 6 May	Add recent electronic technician division actions to the maintenance file.
8 April - 5 May	Process all supply transactions affecting the SIM and outstanding files. Approximately 100 Non-SIM and not-carried transactions were also processed.

DEAS EQUIPMENT USAGE TIMES

Function Performed	At Sea	In Port	Total	Important Averages per Day
A. DEAS System				
1. Training	6:00	6:40	12:40	
2. Creating Data Files				
a. SIM Stock Records	--	12:20	12:20	
b. Outstanding Requisitions	20:40	2:45	23:25	
c. Status	7:30	3:50	11:20	
d. Non-SIM Stock Records	--	3:45	3:45	
e. Maintenance	--	11:10	11:10	
3. Process Normal Supply Transactions	9:25	12:55	22:20	0:42
4. Demonstration, Monitoring, and Additional Backup Tape Creation	7:40	18:15	25:55	
Subtotal	51:15	71:40	122:55	3:51
B. Hardware Testing and Programming	31:25	14:40	46:05	1:26
Total	82:40	86:20	169:00	5:17

NOTE: Times are given in HOURS:MINUTES.

DEAS PROCESSING AVERAGES

Function Performed	Data Entry Time	Update, Review, and Report Time	Total Time	Number of Transactions	Average Number of Transactions Entered	Average Number of Transactions Fully Processed
1. Creating Data Files						
a. SIM Stock Records	9:00	3:20	12:20	365	41	30
b. Outstanding Requisitions	16:30	6:55	23:25	328	20	14
c. Status Messages	7:20	4:00	11:20	124	17	11
d. Non-SIM Stock Records	2:30	1:15	3:45	108	43	29
e. Maintenance	8:10	3:00	11:10	117	14	10
2. Process Normal Supply Transactions	14:20	8:00	22:20	550	38	24
Total	57:50	26:30	84:20	1592	28	19

NOTE: 1. Data entry time includes time required to obtain the transaction from the ship's files.

2. Times are given in HOURS:MINUTES.

3. Averages are given in number of transactions per hour.

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2. Analysis and Evaluation of Existing Methods and Procedures

2.1 Current Shipboard Supply Management Procedures

The storekeepers and supply officers aboard the DE/DD/DL, etc., ship classes currently maintain their records and inventories on a manual basis. Inherently these procedures are subject to error, require continual checking, are overly consuming of human resources, and are not as effective as they should be. This section deals with the operation of the supply department aboard smaller Navy surface ship types. Detailed standard operating procedures are available in existing NAVSUP documents. What follows here is a capsulized view, for the purposes of this report, of the more important actions which occur in the Supply Department. Timing estimates have been made for the execution of each of these tasks. However, these timings are based on the assumption of a neutral work environment and do not represent actual elapsed clock time (including diversions, stoppages, etc.) before each task is actually completed. These timings are intended to provide the background by which shipboard supply operations can be evaluated. Further comments will be presented relating the execution of these tasks to the routine operating environment in which they must be performed.

When the storekeeper (SK) is presented with a request for a part or unit (on a Form 1250) he checks the validity of the part number with the Allowance Parts list microfiche for the latest stock number (NIIN) cross-correlating with later or substitute stock numbers if it is not current. He also checks to see whether it is a SIM or non-SIM* item. The records for on-board materials

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*SIM = items having at least four requests during the previous year.

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are maintained in card files on Form 1114. Having verified the number, the 1114's are searched. These are filed in two sets, in grouped number sequence. One file consists of SIM records; the other non-SIM. Once found the NIIN location is read from the card and noted on the 1250 form. (This look-up requires 10 to 20 seconds for each of the operations.)

Normal requests are transmitted to the storerooms routinely, usually in the morning. No time estimates have been taken on the pulling of stocks from the storerooms.

Stock is updated with the inventory level checked and verified. Any reorders are computed for the batch in 30-60 minutes. If reorder is un-necessary, the 1250 form is separated and (1) one copy is filed for future use in preparing the 10-day financial report, (2) one copy becomes the 3M system reporting copy, (3) one copy is retained as the consumption copy and filed.

The OPTAR desk (requisitioning SK) is the action desk for reordering. The requisitioning SK checks for legibility and places the 1250 in the procurement action file on an urgency basis. It is a full-time job for one man to keep the OPTAR log and to write requisitions (Form 1348's). Approximately 60 percent of his time is spent in checking, breaking 1348's to files, and preparing them for mailing. The remaining 40 percent of his normal workday is spent in maintaining the OPTAR log and financial records. 1348's average 10 forms per day for smaller ships and increase to 20 forms per day for larger ships. Status Cards (reporting on 1348 requisitions) are received by the supply office in a ratio of 3 or 4:1 for each 1348 requisition.

For smaller ships an average of 4 hours per week is spent in filing status cards to the 1348 Outstanding File. Larger ships spend upwards to 10 hours per week in filing status. An additional 1/2 to 1 hour per day is spent on status report preparation. The OPTAR desk is also responsible for preparing monthly and quarterly reports and validating back order forms three to four times per year. (Figures are not included in the overall time estimates for these latter functions.)

Effectively, a similar set of procedures is followed for not-in-stock items. However, an additional posting is required. The stock records SK submits the entire 1250 to the OPTAR SK for processing, after which it is returned in its entirety to the stock records SK who then annotates the 1114.

Not carried items are annotated on the 1250 by the stock records SK. These 1250's again go to the OPTAR desk for record processing and cutting of the 1348's. The 1250 is then returned to the stock record SK who enters it in a historic demand file and a not-in-stock/not-carried (NISNC) file.

SERVMART requests are screened to see whether the items are carried in stock. The 1348 indicates the money value only and are placed in a suspense file until it is completed (upon return from SERVMART). Usually a single 1348 is written to cover several 1250's.

When items are received the 1348-1 or purchase forms are batched to the OPTAR for processing. Arrivals are checked against the stock item lists and locations are rechecked. The NISNC file is checked. The stock record SK

posts the receipt to the stock record card; the 1348-1 is matched with the 1348 and the two forms are placed in the completed file. No time estimates have been established for the receiving operations.

The supply officer and an SK1 prepare the budget and fiscal reports. This effort requires about three hours (approximately one hour for finance center reports and two hours for budget allocation work).

Table 1 summarizes the estimated time allocations for a range of small to larger ships within the current procedures.

The SK's time to perform file checks to locate stock information and provide accurate prices, locations, etc., on various forms, can and has been measured in terms of the seconds and minutes required to execute these operations. However, these measured times can easily be misinterpreted if the environment in which the average SK must work is not considered. The bane of the smaller surface ships is the total shortage of space. In the case of Supply, the office and storekeeping areas are frequently scattered throughout the ship. Furthermore, most working areas on a ship are crowded and difficult to access. In the typical supply office, often the hub of activity, the working space (including desks, multiple files to be accessed, etc.) which accommodates the SK's is even more of a problem than the typical area. For example, the normal stock number cross-check and validation can actually take several minutes of waiting in turn, maneuvering for position, etc. Therefore, in a typical day, SK's may require much more elapsed time to complete their duties than is represented by the estimated raw timings for task execution.

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Table 1 - Estimated Time Allocations
in Current Procedures

	MINUTES PER DAY
Cross-check NIIN (10-20 sec)	1.66 - 20.00
Look-up (10-20 sec)	1.66 - 20.00
Forwarding Time/Batch	--
Posting to 1114	10 - 20
Stock Update/Reorder Computation	30 - 60
OPTAR DESK	
Legibility Check	10
1348 Development/Maintenance	288
OPTAR LOG/Financial Records	192
Status Card Filing	35 - 90
Status Reports	30 - 60
Receiving	--
TOTAL: Minutes	598 - 760
Hours	10 - 12.5

This is due, simply, to the effects of an essentially hostile environment upon the execution of supply office tasks.

A generalized analysis of the effects of the environment of the supply department upon the execution of its functions would show the following problems: 1) oftentimes it takes one to two days to process 1250 request forms, 2) it takes one to two days to process higher priority Direct Turnover Orders (DTO) 1348 Requisitions, 3) from two to three days to process stock replenishment 1348 Requisitions, 4) several days to process 1348 Status Cards, and so on with the multitude of less used forms.

Other time delays in processing supply actions can be attributed to the ever increasing volume of forms, workload requirements of the automated shore based systems, skill level of SK's (training), low morale due to workload and extra duty hours, errors in file updating, restrictive financial budgets, and, finally, errors produced in creation of supply forms.

As a result of the many problems, time delays and working constraints, the majority of duties in today's supply department are clerical and leave no time to perform some of the following important supply management functions.

1. SIM Review — Personnel needed for proper updating, correcting stock records. More frequent physical inventory checks required and accurate counts posted. Consolidate stock locations for easier access to material.

2. Outstanding File — Continuous review and expediting orders. Provide back order reconciliation which is ineffective today.

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3. Historical Demand File - Include frequently ordered items into stock battery.

4. Financial Management - Improve the accuracy of the accounting and reporting systems by more time spent on record keeping and bills payment.

5. COSAL Maintenance - Manpower is needed for continuous updating of the APL (Allowance Parts List) and the ISL (Integrated Stock List). It is also necessary to maintain the various electronic configurations versus the 4110 record (manufacturer's guide). 1220 record listing COSAL updates require additional manpower.

2.2 Current Shipboard Maintenance Procedures

The Navy system for ship maintenance and repair consists of three levels of capability and performs three types of tasks.

2.2.1 Levels

At the Organizational level, maintenance and repair are performed by the ship's force with the ship's facilities.

Requirements that exceed the capability of the ship may be performed by an Intermediate Maintenance Activity (IMA). This activity may be a ship (tender) or a shore-based facility.

The most complex and extensive maintenance tasks are performed by ship-yards. This is the Depot level of maintenance.

There is an overlap of capabilities between these activities, maintenance task assignments will take account of workloads and operational requirements as well as capabilities.

2.2.2 Types

Maintenance tasks fall into one of three classes:

    (1) Repair of failed or worn equipment;

    (2) Planned servicing of operational equipment; and

    (3) Modification of systems or components.

Any of these classes of work may be done by Organizational, Intermediate, or Depot activities.

2.2.3 Reporting System

General

The performance of varied and interdependent maintenance tasks by a variety of activities, each with changing personnel complements, generates the need for comprehensive reporting and record-keeping. The reporting used by the Navy is the Maintenance and Material Management (3-M) system. This system is intended to provide necessary information at all levels, while minimizing the amount of paperwork that maintenance men must prepare.

Purposes

The principal purposes of the 3-M system include:

    (1) Reporting needs for maintenance;
    (2) Assignment of personnel and facilities;
    (3) Setting of priorities;
    (4) Supply coordination;
    (5) Reporting of work accomplished;
    (6) Reporting of equipment maintenance history.

2.2.4 Corrective Maintenance

The basic documentation of a ship's corrective maintenance (including modifications) status is the Current Ship's Maintenance Project (CSMP). The CSMP consists of automated and manual reports of maintenance needs and actions.

For reporting of maintenance needs and actions, form 4790/2K is used. This form is commonly called the TWO-KILO. It is completed by ship's force maintenance personnel to report maintenance needs that will require outside assistance, or will be deferred for more than 30 days, and certain other maintenance or modification actions. The TWO-KILO is also used to report completed maintenance actions. Other pertinent forms are listed in Table I.

Table I - Forms Used in 3-M System

4790/2K	TWO-KILO	Basic report form for maintenance needs and actions.
4790/2Q	TWO-QUEBEC	Similar to TWO-KILO but automatically prepared.
4790/2L	TWO-LIMA	Supplemental data sheet.
4790/2P	TWO-PAPA	Planning and estimating sheet for IMA planning.
4790/2R	TWO-ROMEO	Automated work request for maintenance - prepared by ADP facility.
4790/2F	TWO-FOXTROT	Progress report showing status of work underway.

A TWO-KILO reporting a maintenance need is forwarded through the Maintenance Data Collection System (MDCS). The TWO-KILO data is encoded into a computer by an Automatic Data Processing Facility (ADPF) associated with the ship's Intermediate Maintenance Activity. The encoded data are used to prepare the automated portion of the CSMP, to aid the scheduling of maintenance by organizational, intermediate, and depot activities and to compile records of resources use. The data is also used to prepare equipment maintenance histories for analysis by systems commands or others to determine reliability and maintenance trends.

A simplified routing diagram for 3-M documents is shown in Figure 3.

The automated CSMP report generated by the ADPF, in conjunction with manually-kept records aboard ship reflect the current material condition of the ship.

The commanding officer of the ship can use the CSMP to evaluate:

    (1) The ship's current and projected capabilities;

    (2) The level and extent of upcoming maintenance assistance;

    (3) Maintenance availability time requirements;

    (4) Weaknesses or shortages in skill or resources aboard ship.

Department heads can use the CSMP to coordinate both planned and corrective maintenance work and to evaluate the performance of work centers in their departments.

Type commanders can use the CSMP to coordinate ship's needs with tender capabilities, workload, and budget.

The present method of automated CSMP production, with written forms forwarded to an off-ship ADP facility, results in a delay between the entry of an item into the ship's records and its appearance on the records forwarded to higher echelons and returned to the ship in automated form. Maintenance needs that are expected to be accomplished within 30 days, without off-ship assistance, are not entered into the automated CSMP (exception: INSURV items). These are entered into status-board type records in ship's work centers, but are not consolidated into a single report with the automated portion. Of course critical items of maintenance (actual or impending casualties) are reported through command channels.
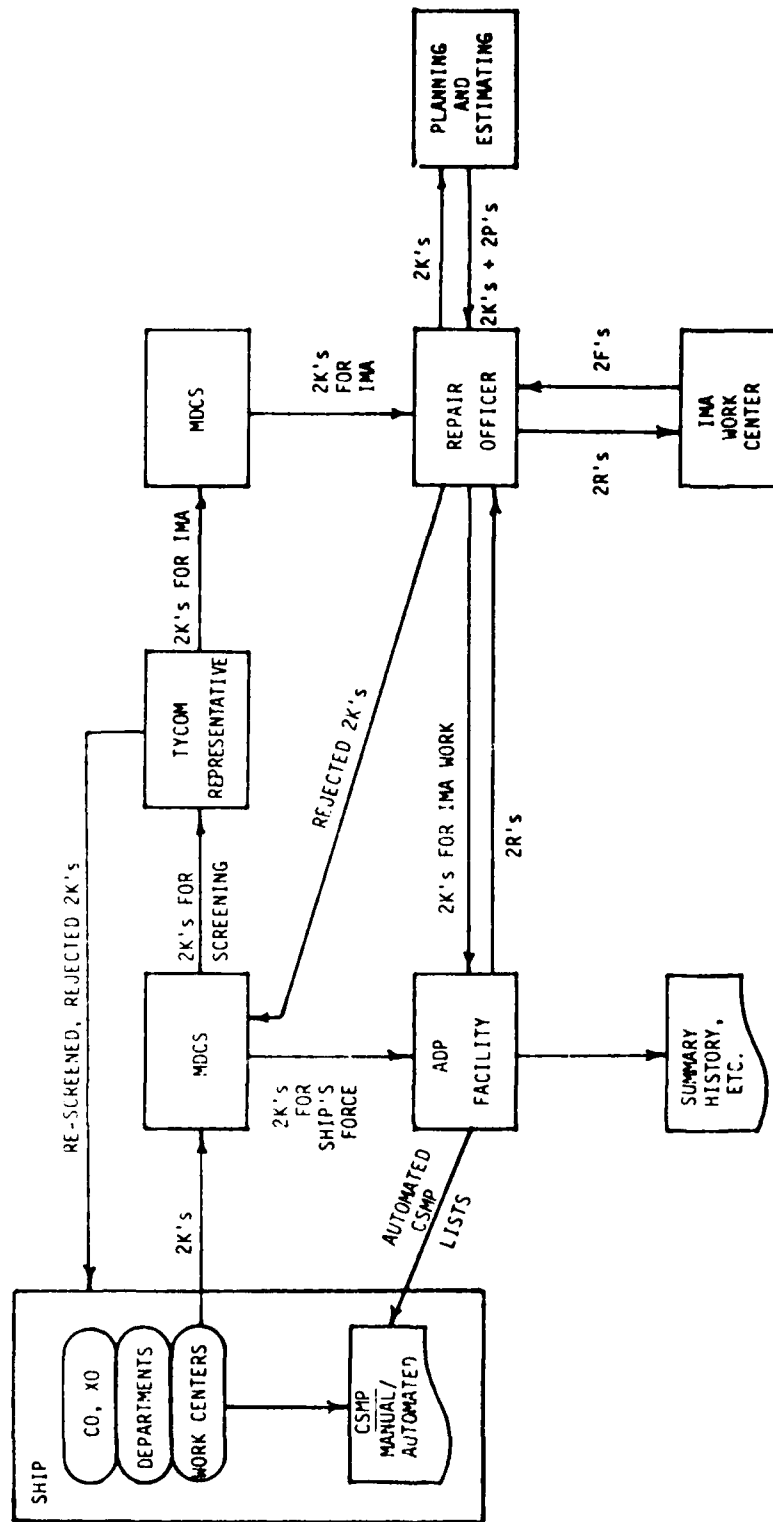
FLOW OF DOCUMENTS IN THE MAINTENANCE DATA SYSTEM

Figure 3

2.2.5 Planned Maintenance

The Planned Maintenance Subsystem (PMS) is a part of the 3-M system designed to provide comprehensive planned maintenance of systems and equipment and to aid in maintenance planning and scheduling. Such actions as cleaning and lubricating, testing and adjusting, comprise PMS tasks. The PMS requirements of each system are listed on a system of Maintenance Requirement Cards (MRC's) which are indexed on Maintenance Index Pages (MIP's). The MIP's are indexed in a List of Effective Pages (LOEP) for each work center.

Because of the variety of modifications of systems and system components, and the variety of equipments aboard ships even of the same class, considerable "bookkeeping" is required to assure that current PMS requirements are in effect at the work centers.

2.2.6 Data Consolidation

In addition to providing communication between activities performing fleet maintenance and repair activities, the Maintenance Data Collection System (MDCS) consolidates data on the serviceability of equipment, for analysis by systems commands and equipment designers. Designs may thus be improved to alleviate problems discovered in service. The data furnished by operating units are encoded onto magnetic tape by the supporting ADP facilities and forwarded to the Navy Fleet Material Support Office (FMSO) in Mechanicsburg, Pennsylvania. Supply data are consolidated and analyzed by systems commands or inventory control points (ICP's).

2.2.7 Supply Support

Replacement parts and maintenance supplies are ordered by maintenance personnel through the ship's supply department. Material may also be obtained by cannibalization, salvage, or local manufacture. A supply support center (SSC) serves as point of contact between Maintenance and Supply Departments.

2.3 Current Ship-Shore Information Transfer Description - Summary

The Data Entry Aboard Ship (DEAS) Information Networks Study entails determining the feasibility and merits of changing the method of handling shipboard (destroyer) logistics data. This includes an analysis of the resources and procedures used to transfer:

- Outgoing data messages directly to the assigned Naval Supply Center (NSC) computer facility or indirectly by shipboard communications systems via AUTODIN entry points.

- Incoming formatted messages that facilitate the timely update of shipboard logistics records.

This study is being conducted in three phases.

In phase 1 of this study a functional description has been developed that represents the current logistics information processes (see Table 1 - List of Functions Described) performed by ashore facilities that interface with COMNAVSURFLANT ships (destroyers) in port or operating at sea (see Figure 4 - Information Flow Network (In Port) and Figure 5 - Information Flow Network (At Sea)). Analyses have been made of the current destroyer ship-shore (In Port and At Sea) information requirements, flow processes and equipment (see Table 2 - Information Requirements Totals - Peak Day and Table 3 - Ship Equipment Characteristics). These requirements were applied to ten operational situations (two in port and eight at sea) for which networks were synthesized. The current shipboard equipment has been described in terms of both characteristics and configurations in which they are used in implementing the existing radio communications methods. Finally, a method is

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proposed for the transfer of information between a DEAS-equipped ship (in port) and the local NSC computer facility. Table 4 (Proposed Ship-Shore Trunk Requirements (NSC Norfolk)) indicates the number of trunks required for the noted Overhead (administrative traffic), Percentages and Probabilities of Loss (a user not finding a trunk available).

This section was excerpted from DTNSRDC Report 4704, DEAS INFORMATION STUDY, PHASE 1 - Current Ship-Shore Information Transfer Description, June 1975. For a detailed description of the described analysis refer to that report.

TABLE 1 - LIST OF FUNCTIONS

IN PORT

MEANS OF TRANSFER

- Shore Bases Message Service System (SBMSS)
- Land Line
- Handcarry
- Telephone (dial-up, voice)
- Mail (CONUS)
- Remote Terminal
- AUTODIN

PROCESSING ACTIVITIES

- Logistic Requestor
- Logistic Managers
    - Navy Inventory Control Points
    - GSA Regional Office
    - DSA Center
- Supply Sources
    - Naval Supply Center
    - GSA Depot
    - DSA Depot
- Message Adjuster
    - Defense Automatic Addressing System (DAAS)
    - Naval Communication Station
    - AUTODIN Switching Center (ASC)

ACCOUNTING FACILITY

- Navy Regional Finance Center (NRFC)

Table 1 - Continued

MEANS OF TRANSFER

- Mail (at Sea)

- Ship-ship Manual Transfer

- Visual Signals (Blinkers)

- Radio Signals

PROCESSING ACTIVITIES

- Logistic Requestor

- Logistic Managers
    - AFS
    - Other Managers

- Supply Sources
    - Support Ship
    - Other Sources

- Message Adjusters
    - Communications Relay Facilities
    - AFS
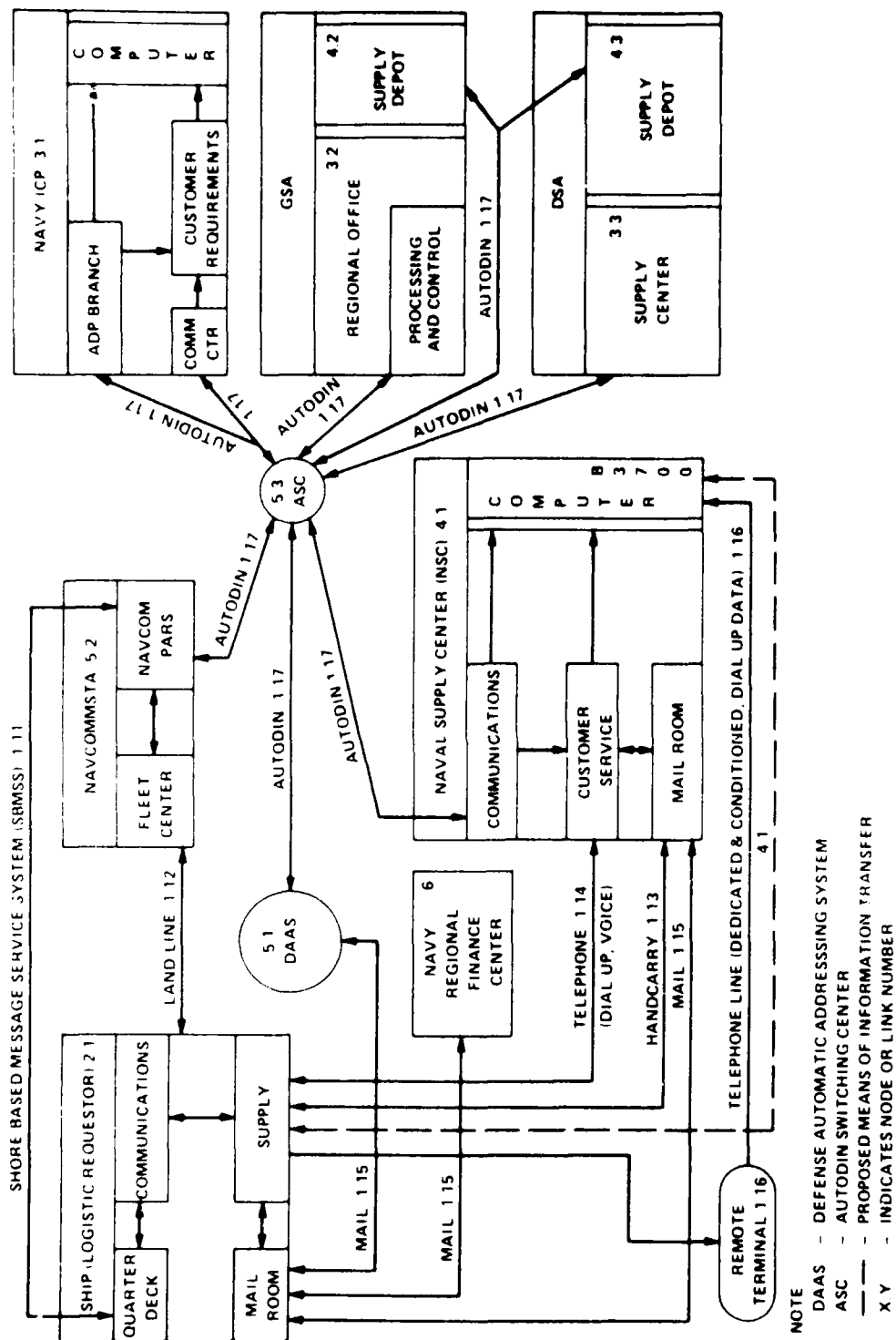   - Primary Ship
    - Support Ship

Figure 4 — Information Flow Network (In-Port)

Figure 5 — Information Flow Network (At-Sea)

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TABLE 2 - INFORMATION REQUIREMENTS TOTALS* - PEAK DAY

SCENARIO SITUATION	INDIVIDUAL SHIP		AREA	
	INCOMING	OUTGOING	INCOMING	OUTGOING
Non-Restricted, Non-Scheduled, Independent, IPG III, In Port	1758	3112	29586	36873
Non-Restricted, Deploying, Independent, IPG II, In Port	2191	5747	4382	8574
Non-Restricted, Non-Scheduled, Independent, IPG II, III, At-Sea	447	782	4227	2389
Non-Restricted, Emergency, Independent, IPG I, II, At-Sea	111	82	222	164
Non-Restricted, Scheduled, Group, IPG III, At-Sea	200	3695	1200	22170
Non-Restricted, Non-Scheduled, Group, IPG III, At-Sea	126	192	659	960
Non-Restricted, Emergency, Group, IPG I, II, At-Sea	205	82	410	164
Restricted, Scheduled, Group, IPG II, At-Sea	200	3695	1200	22170
Restricted, Non-Scheduled, Group, IPG II, At-Sea	64	192	256	960
Restricted, Emergency, Group, IPG I, II, At-Sea	205	82	410	164

* Measured in words

TABLE 3. SHIP EQUIPMENT CHARACTERISTICS

ITEM	NOMENCLATURE	FUNCTION	OPERATION	INPUT	OUTPUT
TELETYPEWRITER	AN/UGC-6	CUTS PAPERTAPE	MANUALLY ASSISTED	KEYBOARD CHARACTER	PUNCHED PAPER TAPE
		CORRECTS PAPER TAPE	"	INCORRECT PAPER TAPE	CORRECTED PAPER TAPE
		READS PAPER TAPE	AUTOMATIC	PUNCHED PAPER TAPE	DIGITAL SIGNALS
		SENDS MESSAGES	"	PUNCHED PAPER TAPE	DIGITAL SIGNALS
		RECEIVES MESSAGES	"	DIGITAL SIGNALS	HARD COPY
		PRINTS HARD COPY	"	DIGITAL SIGNALS	HARD COPY
PAGE PRINTER	AN/UGC-25A	MESSAGE RECEIVER (HARD COPY ONLY)	"	DIGITAL SIGNALS	HARD COPY
CRYPTO UNIT	KWR 7	ENCRYPTS/DECRYPTS ELECTRONIC SIGNALS	"	DIGITAL SIGNALS	DIGITAL SIGNALS
	KWR 37	ENCRYPTS/DECRYPTS ELECTRONIC SIGNALS	"	DIGITAL SIGNALS	DIGITAL SIGNALS
	KWR 14	ENCRYPTS/DECRYPTS ELECTRONIC SIGNALS	"	DIGITAL SIGNALS	DIGITAL SIGNALS
SIGNAL CONVERTER	CV-2460/SGC	CONVERTS AUDIO TONES TO DIGITAL SIGNALS AND VICE VERSA	" "	DIGITAL SIGNALS / AUDIO TONES	AUDIO TONES / DIGITAL SIGNALS
	UCCI	CONVERTS AUDIO TONES TO DIGITAL SIGNALS / SEPARATES FREQUENCY CHANNELS	"	AUDIO TONES	DIGITAL SIGNALS
	AN/URA-17	CONVERTS AUDIO TONES TO DIGITAL SIGNALS AND VICE VERSA	"	AUDIO TONES / DIGITAL SIGNALS	DIGITAL SIGNALS / AUDIO TONES
RECEIVER (HF)	R1051	CONVERTS HF/UHF TO AUDIO TONES	"	RADIO WAVE (HF/UHF)	AUDIO TONES
	AN/SRR-19	CONVERTS HF/UHF TO AUDIO TONES	"	RADIO WAVE (HF)	AUDIO TONES
TRANSCEIVER (UHF)	SRC 20 / SRC 21 / URC 9	CHANGES AUDIO TONE TO RADIO FREQUENCIES OR VICE VERSA BY MODULATION/DEMODULATION	"	AUDIO TONES/RADIO FREQUENCIES	RADIO FREQUENCIES / AUDIO TONES
TRANSCEIVER (HF)	URC 32	CHANGES AUDIO TONES TO RADIO FREQUENCIES AND VICE VERSA BY FREQUENCY SHIFT KEYING	"	AUDIO TONES/ RADIO FREQUENCIES	RADIO FREQUENCIES/ AUDIO TONES
TRANSMITTER (HF)	AN/URT 23	CHANGES AUDIO TONES TO RADIO FREQUENCIES BY FREQUENCY SHIFT KEYING	"	AUDIO TONES	RADIO FREQUENCIES
	AN/WRT-2	"	"		
TYPEWRITER	OCR	PREPARES MESSAGES FOR OPTICAL CHARACTER RECOGNITION	MANUAL	OPTICAL CHARACTERS	HARD COPY

TABLE 4 - PROPOSED SHIP-SHORE
TRUNK REQUIREMENTS (NSC NORFOLK)

PROBABILITY OF LOSS	OVERHEAD PERCENTAGES		
	25	50	100
.01	4	4	5
.1	2	3	3

NOTE: Number of trunks indicated is determined to
the nearest integer value.

3. Alternative Methods and Procedures

The purpose of the DEAS project has been to test and evaluate the feasibility of utilizing intelligent terminal technology as the means of providing automation for shipboard logistics operations. Although that investigation has been the primary thrust of the project, some evaluation of alternatives to DEAS has been undertaken. The DEAS approach is recommended because it automates practically all supply and maintenance functions and complies with CNO directives that ADP hardware and software procured for small ships must support the needs of all shipboard ADP data system users. However, DEAS and its alternatives are compared briefly below.

3.1 Alternative I

3.1.1 Discussion

Continue the present manual mode of operation. Assume the same current reduced ships manning document (SMD) strength.

3.1.2 Evaluation

Retaining the current operating procedures under the present reduced staffing is unsatisfactory. Present procedures are geared to a full complement of shipboard personnel. This mismatch of procedures and existing manning levels is the source of current problems. To continue the existing logistics management environment would prolong those problems which inhibit providing satisfactory logistics support and which are, consequently, detrimental to the readiness of the combat fleet. To merely maintain the status quo will not only perpetuate this unsatisfactory situation but will ensure that logistics

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support and consequently fleet readiness will deteriorate *further* as budgets decrease and material costs increase. The logistic's systems current inability to adequately meet its responsibilities would become magnified to disastrous proportions.

3.1.3 Limitations

This alternative will cause no change or improvement in the current unsatisfactory situation. It will lead to continued, disastrous deterioration in shipboard logistics support.

3.1.4 Training

No training is required.

3.1.5 Costs

No additional monetary costs are incurred; however, the state of fleet combat readiness will be very adversely affected.

3.2 Alternative II

3.2.1 Discussion

Data Entry Aboard Ship (DEAS) is designed to meet the non-tactical ADP needs of selected combatants and auxiliaries by utilizing small, stand-alone, intelligent terminals for local data manipulation. The system will consist of a stand-alone CPU, a CRT-display, random access and serial storage media, and a hard-copy printer. It will also have the ability to transmit data over either telephone lines or AUTODIN to supporting activities. The equipment will be located in the functional areas and will require space on one to two desk tops. No special environment will be required. Spare parts and/or units

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will be available for maintenance and replacement. Software systems will be turn-key operations requiring little training and virtually no ADP experience. The systems will be tutorially and functionally oriented so that impact on functional area personnel will be minimal. Software systems will be provided to include virtually all shipboard logistics processing, both local and input to remote systems. Data entry procedures for data collection and storage and transmission will be provided. Data entry will be a part of normal office functions. Shore-side reporting of data will be generated from daily entries by automated procedures. In addition to supporting higher-level reporting requirements, local record keeping and control (inventory, budget, CSMP, reorder, requisition status, etc.) will be provided. DEAS will provide a local ship oriented management system.

3.2.2 Evaluation

DEAS incurs the least cost as well as requiring minimal space and training. Standardized, turn-key software will provide a new uniformity of operations among surface ships for logistics and other administrative functional areas. Manual processing will be alleviated by a stand-alone, local automated system. Shore-side reporting requirements will be met automatically as a spin-off of local processing thereby alleviating a large clerical load. Data can be transmitted electronically to the NRFC, MSOD, NFG, etc. DEAS equipment can be tied into the NSC when in port. This direct electronic connection to shore-side supply computer systems will speed the transmission of requisitions and the receipt of status, eliminating paperwork and time. When at-sea DEAS can be connected to the message center and eliminate some preparation and transfer efforts. DEAS will provide processing relief for both local and higher-level requirements which currently burden the non-automated surface fleet.

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3.2.3 Limitations

There are no outstanding limitations related to DEAS.

3.2.4 Training

The DEAS systems will be turn-key operations and tutorial in nature. Therefore, training for functional area clerical personnel will be minimal. The training required for each individual is estimated (based on shipboard experiments) at 20 manhours. This training would not have to be a separate course but could be incorporated into the normal training which SK's and other disciplines receive. For the initial implementation, training of crews will be on the job, therefore, training teams may spend 1-5 days at each ship on which DEAS is being implemented or arrange for cooperative training of multiple crews by scheduling the implementation of several ships simultaneously.

3.2.5 Costs

Over a six year period (FY 78-82), the cost of DEAS is $15,279,000.00.

3.3 Alternative III

3.3.1 Discussion

Use of the AN-UYK-20 mini-computer. This equipment is the standard Navy mini-computer for tactical applications. It and its primary peripherals are ruggedized beyond the requirements of the operating environment for non-tactical functions. However, the computer could be used with peripherals ruggedized to the level required for non-tactical applications.

3.3.2 Evaluation

This hardware is more expensive than DEAS equipment. It also requires a dedicated space outside the functional areas. A trained, dedicated operator would be necessary.

3.3.3 Limitations

This system will require dedicated space when a major problem of the current situation is a shortage of space. It will also require a dedicated operator when manning levels for existing functional areas are already below what is acceptable. Billets for new functions are not available.

3.3.4 Training

In addition to training functional personnel, more complex training will be required for the ADP specialist operator.

3.3.5 Cost

Cost of this alternative over the six year period is $28,452,000.00.

3.4 Alternative IV

3.4.1 Discussion

Raise shipboard manning levels back to SMD strength. Presumably this would permit the proper execution of existing procedures. As an example of the numbers involved, if only the supply department were raised, two additional enlisted men in the E4/E5 rating would be required for that office on each of 325 ships. Additional personnel would be required for the maintenance and administrative functional areas.

3.4.2 Evaluation

This alternative has definite drawbacks. Considering only the supply department, for example, 650 additional E4/E5 billets would be required. More billets would be needed for maintenance and administration. There is a very significant cost associated with the quantities of personnel involved in assignments of this magnitude.

More importantly, however, application of additional billets to the problem of shipboard logistics control would prove merely to be temporary catch-up effort. In the future, as logistics management support becomes more demanding due to continuing budget reductions, increasing material costs, and increasing sophistication of weapons systems, this temporary alleviation of the manpower shortage is doomed to failure. Although the current deterioration may be momentarily halted, the current environment of continuous deterioration of logistics support would eventually be revived. Even now, however, it is highly questionable as to whether a solely manual solution to logistics management problems will, in fact, stabilize the current adverse situation. And even if those measures did succeed, their success most assuredly, without automation, would be temporary.

3.4.3 Limitations

Benefits derived from this alternative would be only temporary and would not justify its cost.

3.4.4 Training

Training would merely be an extension of existing procedures.

3.4.5 Costs

Cost of this alternative over the six year period would be in excess
of $33,930,000.00 (this figure is based on the known supply department
requirements and does not include cost of additional manpower for maintenance
and administrative functions).

4. Recommendations

4.1 Conclusions

It is the conclusion of this report that the DEAS concept has been demonstrated to be feasible and practical as a vehicle for providing the non-automated surface fleet with both data capture and local information handling capabilities. There are three primary features within the DEAS concept which are the cornerstones from which its practical benefits are derived. These features are: (1) the use of electronic data entry techniques and tutorial operation for data capture, (2) the provision for file maintenance systems and data bases as stand-alone local ship facilities operable by the available non-ADPE oriented crew personnel, and (3) the electronic transmission (by direct wire or by transferring electronic storage media) of shipboard generated data to shore processing facilities. The use of these DEAS capabilities aboard ship would enable the shipboard departments to meet their management, control, and reporting requirements in spite of the personnel manning deficiencies which now exist. Therefore, DEAS should be developed and implemented in an operational configuration.

4.1.1 Feasibility

With respect to the feasibility of the DEAS concept there are three critical areas in which its concepts had to be proven. The successful demonstration of these factors represented the transition from DEAS in a laboratory environment to DEAS in the actual shipboard environment. The following conclusions are offered.

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- DEAS has demonstrated that a significant processing capacity can be developed on intelligent terminal hardware. By implementing the major aspects of supply inventory control, DEAS demonstrated that a sophisticated stand-alone shipboard management system can be provided on the proposed equipment. DEAS can, in addition to supporting the less complex data capture problem, provide the support needed for the major management control functions (supply, maintenance, administration) aboard ship. Furthermore, smaller combatants will no longer have to depend upon tenders and shore processing centers for what are essentially local reporting needs.

- DEAS has demonstrated that a sophisticated and automated management control system can be developed and packaged in a black-box system which can be operated by sailors with no special ADPE training. It has been demonstrated that sailors can be trained to use such a system, because of its tutorial design, in a matter of hours. Furthermore, the DEAS ship trials illustrated that not only would this system improve the level of competency in the supply and other offices, but that it also has value as a morale booster for those crew members involved in using the system.

- DEAS has demonstrated that intelligent terminal hardware is sufficiently durable and reliable under difficult environmental conditions so as to be suitable for shipboard application. Over a period of one and one-half years the DEAS breadboard hardware has been transported to the demonstrations, via automobile and airplane, at Washington, D.C., Norfolk, Virginia, Mechanicsburg, Pennsylvania, and San Diego, California. On ship trials (U.S.S. ALBANY and U.S.S. MULLINNIX), it survived at sea conditions including sea-state six seas and high-speed maneuvers. Throughout all of these stresses the equipment never failed. Therefore, any required militarization would be minimal and will be defined under a DEAS task being conducted by the Naval Electronics Laboratory Center (NELC).

4.1.2 Benefits

There are a considerable number of benefits which will be derived from

the implementation of DEAS. Some benefits are related to shoreside functions

but most relate to improvements in the quality of functions performed aboard

ship. However, only a few of the projected benefits are of a type which can

be quantified for cost justifying the DEAS implementation. Furthermore, the

significant quantifiable benefits relate primarily to diminished need for

shore personnel and diminished use of non-tactical supplies. Specific benefits

of this type are listed below.

(1) Through the use of electronic data capture techniques, the need
     for shore personnel currently engaged in keypunch, key
     verification, and handling of data forms received from the fleet
     will be eliminated. This data will now be provided directly to
     the shore facility either by direct electronic transfer or on
     machine readable storage media.

(2) The introduction of shipboard data entry techniques will virtually
     eliminate the shipboard use and preparation of many standard
     forms such as the 1348, 2-Kilo, etc.; thereby reducing paper costs.

(3) The automation of shipboard management files will eliminate the
     need for the large quantities of hard copy, file storage equipment
     now employed.

However, the most significant benefits which will accrue from DEAS are

those which relate to the quality of shoreside service, the quality of fleet

related data or the quality of performance within shipboard functions. There

will be improvements to shoreside functions which provide logistics support to

the fleet and directly impact fleet preparedness. There will be improvements

ashore in the quality of data collected from the fleet and used for analysis

and support of fleet readiness. There will be improvements in the ability of

the shipboard command and crew to perform its management control functions.
In particular, the shipboard benefits will involve improved utilization of
existing personnel and increased efficiency in executing logistics functions
which impact the operational preparedness of the ship. Although these benefits
are difficult to quantify in terms of value, they, in fact, have far more
impact upon the fleet than the quantifiable benefits of DLAS. The major
qualitative benefits are shown below.

(1) Electronic, shipboard data capture and source verification will
greatly increase the quality of data being received from the
fleet and will virtually eliminate a forms rejection rate which
ranges as high as 10 to 50 percent.

(2) The improved quality and timeliness of data electronically
collected aboard ship and the subsequent elimination of data
massaging steps at shore facilities, will greatly increase the
accuracy and value of shore data bases (3-M, etc.), which are
intended to reflect fleet conditions and provide input for
command decisions.

(3) The availability of a local, stand-alone processing capability
aboard ship will provide the following benefits:

(a) Provide local inventory control, financial control,
maintenance control and administrative control as
part of one coordinated system,

(b) Reduce and probably eliminate errors and omissions
in stock battery records such as: an average 30-35
percent of records with incorrect high/low limits,
unit price, etc.,

(c) Providing improved stock battery control so that
conditions such as having 12 percent of the stock
battery below reorder point no longer occur,

(d) Provide automated aids and procedures to help the
Supply Officer select the most appropriate items for
reorder within the limits of his budget,

(e) Provide an automated historical demand file for
improved analysis of supply usage,

(f) Improve the stock reorder cycle by providing more
accurate requisition data and in a form directly
acceptable by supply center computers,

(g) Provide accurate and up-to-date status information on outstanding requisitions,

(h) Provide improved financial control over supply funds so that better use is made of available funds,

(i) Provide an automated OPTAR log,

(j) Improve personnel morale by eliminating tedious clerical duties and by introducing a more controlled office environment,

(k) Relieve supply personnel of tedious tasks so that more time is available to: (1) conduct physical inventories of stocks so that stock file records can be adjusted and kept up-to-date, (2) manage physical arrangement of stock items including consolidation for easier access and more efficient use of storage space, and (3) conduct continuous review and reconciliation of back orders.

(4) The DEAS system will also provide benefits to the shipboard maintenance office:

(a) Direct access to parts availability data for improved maintenance planning,

(b) Automated preparation of the 2-Kilo form,

(c) Provide a locally produced CSMP report which relates parts availability (1250's) and outstanding requisitions to the corresponding maintenance action,

(d) Provide a completed job listing and other maintenance control data.

(e) Improve the scheduling of maintenance because of improved parts availability information,

(f) Reduce equipment down time due to improved maintenance control.

As a result of a DEAS implementation, the shipboard logistics teams would provide more effective support toward keeping Navy ships in a state of combat readiness.

The DEAS breadboard concept can be summarized by the following:

- DEAS is a system of programs which provide for the accurate collection of all forms data utilized by the supply department and the 3-M reporting system. DEAS also gives each ship its own file update capability and provides needed reports for managerial decisions.

- DEAS is tutorial in operation and is controlled and operated by personnel with no ADP experience. In fact, results from shipboard tests prove that the DEAS system is an effective and efficient training tool which supplements the training received by sailors in their selected skill levels.

- DEAS is a small desk-top intelligent terminal which provides for data transmittal to larger computer systems plus an advanced ADP system of programs and reports usually found in larger specialized computer systems.

- Input forms' data entered through DEAS are monitored by the intelligent terminal itself. The typical supply department staff monitors the DEAS supply system only to the extent of checking reject lists (Audit Trail) and the program reports. The DEAS 3-M system reports are easily monitored by the ship's C.O. and department staff.

4.2 Proposals

The following sections contain general recommendations as to the structure (hardware and software) of an operational DEAS. The concepts embodied in these recommendations are based on knowledge gained through experimentation with the DEAS Breadboard System and investigation of existing manual operations.

4.2.1 Hardware Concept Recommendations

This section describes the general hardware requirements which will be associated with DEAS. It covers three basic aspects: (1) types of hardware, (2) hardware requirements by application, and (3) hardware configurations by ship class (top and bottom classes only).

4.2.1.1 DEAS Hardware Components

4.2.1.1.1 Intelligent Terminal

- Central processing unit consisting of a micro-processor and controllers for all peripheral devices and features, including a minimum of 32K bytes of programmable random access memory in addition to the basic operating system read only memory. It must be capable of supporting at least 3 remote terminals in a multi-user, multi-tasking environment.

- Monitor for visual display capable of displaying at least 1600 characters with a 5 x 7 dot matrix (or better resolutions). It must include the capacity for text highlighting by blinking, underlining, reverse video, brightness, or color.

- Keyboard comprised of graphic keys in a standard typewriter format, with at least 10 function keys usable in conjunction with programmed operations, and a separate numeric keypad, all in a single unit.

4.2.1.1.2   Remote Terminals

- Controllers for peripheral devices and
  features capable of interacting with an
  intelligent terminal for remote processing.
  Unit should be upward compatible with the
  intelligent terminal by appropriate hardware
  enhancements.

- Monitor (same as for intelligent terminal).

- Keyboard (same as for intelligent terminal).

4.2.1.1.3   Intelligent Terminal Peripheral Devices

- Noiseless high speed printer capable of
  printing at least 2000 characters per second.
  A noiseless printer is recommended because of
  the already high noise levels within a normal
  ship environment. Since printers will be
  located in ordinary office space, it is important
  that no further work distractions or possibly
  hazardous noise levels be introduced into those
  areas. The high speed of the printer is
  recommended for two reasons: (1) to keep pace
  with the interactive mode of operation whenever
  printing is required, (2) to produce large
  volume emergency back-up listing, on a periodic
  basis, in a reasonable length of time.

- Random access storage. Small economical random
  access storage is mandatory to support the type of
  activities inherent in shipboard logistics require-
  ments. Use of this type of equipment will provide
  rapid file searching, immediate posting to files,
  and the management data reaction time required by
  department heads and the commanding officer.
  Storage should be militarized, nave hand changeable
  modules (such as floppy discs or a militarized
  derivative thereof), and be sufficiently compact
  and maneuverable to fit int the logistics office
  areas.

- Serial access storage in the form of cartridge
  tapes and tape drives having a minimum capacity
  of 2.8 megabytes per tape. Large serial storage
  is necessary to accommodate thousands of
  relatively inactive records. These records are
  accessed and processed on a relatively infrequent
  basis. For this reason inexpensive serial storage
  is sufficient. Cartridge equipment is available
  in militarized versions and is sufficiently high
  speed and has sufficient data density to meet the
  access requirements of this application.

- Communications equipment in the form of communica-
  tions controller (internal or external), adapter,
  and modem capable of varying transfer rates of
  from 110 BPS to 9600 BPS. The ability to connect
  to the current shipboard communications network
  may also require a paper tape punch/reader.

4.2.1.1.4 Remote Peripheral Device

- Noiseless medium speed printer capable of printing
  at least 120 characters per second to be used in
  conjunction with a remote terminal.

4.2.1.2 DEAS Data Storage Configurations

This section will describe the hardware storage configuration requirements

of DEAS in terms of projected minimums for the two extremes in the range of

ships currently proposed for DEAS installation. Configurations for all other

ships would fall between the two extremes (DE and CG). It is of critical

importance to determine storage (data) requirements aboard ship and the

division of that storage between random access units (disc) and serial units

(cartridge tape).

Based on the DEAS Breadboard System our most precise knowledge of data

requirements is related to the Supply Department. Consequently Table A,

which follows, presents a very realistic measurement of the data storage

requirements of that department. The values in the table assume several things: (1) that the SIM, Not-Carried and 5-10 percent of the Non-SIM stock battery account for 95 percent of a ship's stock movement and, therefore, only those stock records have operational value on random access storage, (2) that outstanding requisitions and status would be kept on random access storage, (3) that the remaining stock items (the bulk of the stock battery) are so infrequently used and accessed that serial storage is sufficient, and (4) that additional storage would be needed for transactions, programs and working storage.

TABLE A - SUPPLY DEPARTMENT STORAGE REQUIREMENTS

SHIP CLASS

STORAGE TYPE		DD/DE	CG
	CARTRIDGE TAPE DRIVES	2	4
	DISC UNITS	4	9

(Note, each cartridge tape is assumed to hold 2,880,000 bytes and each disc unit is assumed to hold 250,000 bytes.)

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A further breakdown of these figures (Table B) shows the estimated number of records per file, including estimates of the file requirements within the Maintenance and Administrative departments. The figures shown in this table represent numbers of records and assume 128 bytes per record.

TARLE B - RANDOM ACCESS STORAGE REQUIREMENTS

USAGE	SHIP CLASS/RECORDS	
	DD/DE	CG
• SIM FILE	900	1400
• 1348 OUTSTANDING FILE	2000	6000
• ACTIVE NON-SIM	1800	5600
• FINANCIAL DATA, PROGRAMS, WORKING STORAGE	3300	5000
• ADMINISTRATIVE	2000	4000
• MAINTENANCE	2000	4000
TOTAL	12,000	26,000

Since each disc unit is assumed to hold approximately 2000 records, the following breakdown of random access storage units emerges.

TABLE C - RANDOM ACCESS STORAGE UNITS

	SUPPLY	ADMINISTRATIVE	MAINTENANCE	TOTAL
DD/DE	4	1	1	6
CG	9	2	2	13

With respect to serial storage (cartridge tapes with a 2.8 megabyte capacity are assumed), Table D shows those projected requirements. The figures in Table D represent number of tape drives required for the system. For supply an assumption is made that sufficient tape drives will be available to permit the complete Inactive Non-SIM file to be in a ready mount state at all times. For larger ships that means that multiple tape drives will be required for the Inactive Non-SIM stock file (assuming 16K records for a DD/DE and 50K records for a CG). With respect to the Inactive Non-SIM file, it would be possible to limit the number of tape drives to one per ship. For ships where that file requires multiple tapes (3 tapes for a CG), the correct tape would have to be identified and mounted on the drive, designated for Inactive Non-SIM, for each access (the system would be able to identify the tape to be mounted and would notify the supply clerk operator). The additional time required for such handling would be small. Furthermore, since the Inactive Non-SIM file repre-sents less than 5 percent of the activity, this more restricted tape access

procedure may be acceptable (particularly since it would save two tape units per ship).

TABLE D - TAPE DRIVE REQUIREMENTS
BY SHIP CLASS AND USAGE

USAGE	SHIP CLASS	
	DD/DE	CG
INACTIVE NON-SIM	1	3
WORKING STORAGE	1	1
MAINTENANCE	2	2
ADMINISTRATIVE	2	2
TOTAL	6	8

Additional Supply Department files which would be maintained on tape but would not require dedicated tape drives are: historical financial data, historical demand data, completed requisitions, ship stores, and food service.

It is also assumed that drives assigned to maintenance and administration would be located at the sites of their terminals and would be used primarily for storage and historical data capture.
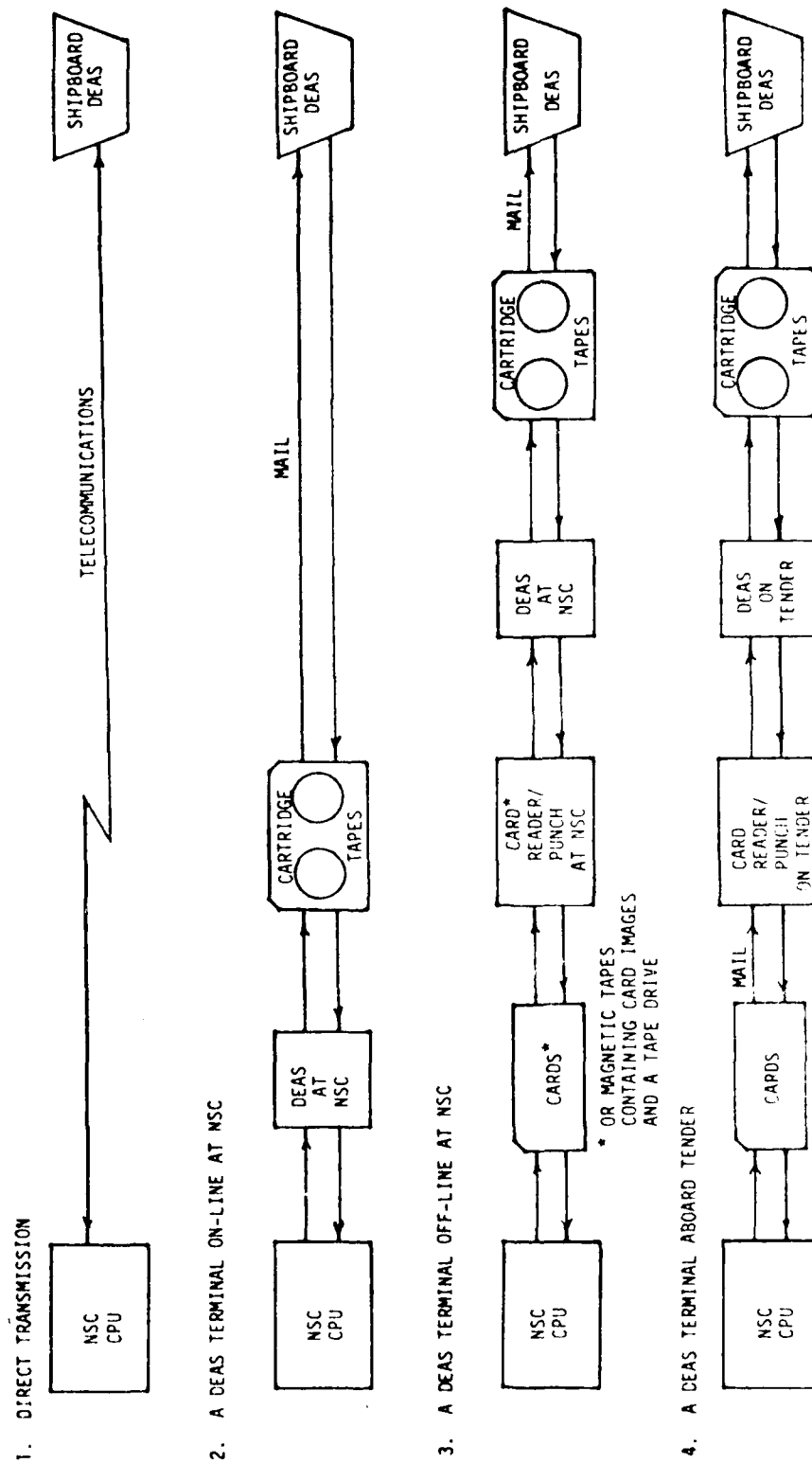
4.2.1.3 *Proposed DEAS Data Transmittal Configurations*

A key aspect of DEAS is the transmittal of data from the ship to the
Navy Supply Center computers ashore and the receipt of data from those same
computers. There are two primary transmission modes which have been postulated
for DEAS: (1) at dockside; transmission and receipt of data via direct tele-
phone connection, (2) at-sea; transmission and receipt of data via the mailing
of a digitized media. Figure 6 depicts these transmittal modes. In particular
it depicts alternative ways of handling the transmittal of data via storage
media. A basic intent of these graphs is to illustrate that card processing
equipment (with its significant cost across the projected 325 ships) is not
necessary within the DEAS configuration. It is possible, and at a savings of
considerable funds, to insulate the DEAS fleet from card handling and
processing.

Example 4 of Figure 6 postulates a DEAS system as an interface aboard
Navy Tenders. Not only would the installation of the DEAS system on-board
tenders accomplish the aforementioned interface, but, additionally, the DEAS
system on board tenders could be utilized as a front-end system to the
existant or an upgraded SUADPS-EU system. Front-ending the SUADPS system
would eliminate much of the existing burdens placed on SUADPS by: 1) reducing
keypunch needs to a minimum (data entry), and 2) providing SUADPS with greatly
increased print capabilities.

Figure 6

POSSIBLE NSC/SHIPBOARD DEAS INTERFACES

1. DIRECT TRANSMISSION

2. A DEAS TERMINAL ON-LINE AT NSC

3. A DEAS TERMINAL OFF-LINE AT NSC

* OR MAGNETIC TAPES
  CONTAINING CARD IMAGES
  AND A TAPE DRIVE

4. A DEAS TERMINAL ABOARD TENDER

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4.2.1.4 DEAS Intelligent Terminal Configurations

This section presents briefly the minimum hardware configurations for a DEAS intelligent terminal. Two minimum configurations are presented: (1) for smaller class of ships (DD/DE), (2) for largest class of ships (CG).

4.2.1.4.1 Smallest Class of Ships (DD/DE)

The minimal shipboard configuration recommended for the smallest class of DEAS ships is:

- Supply Area

    - One intelligent terminal

    - One high speed printer

    - Random access storage of at least 1.5 megabytes

    - Serial access storage of two cartridge tape drives

    - Communications hardware, including a paper tape punch if necessary

    - One remote terminal with a medium speed printer

- Maintenance Area

    - One remote terminal with a medium speed printer

- Administrative Area

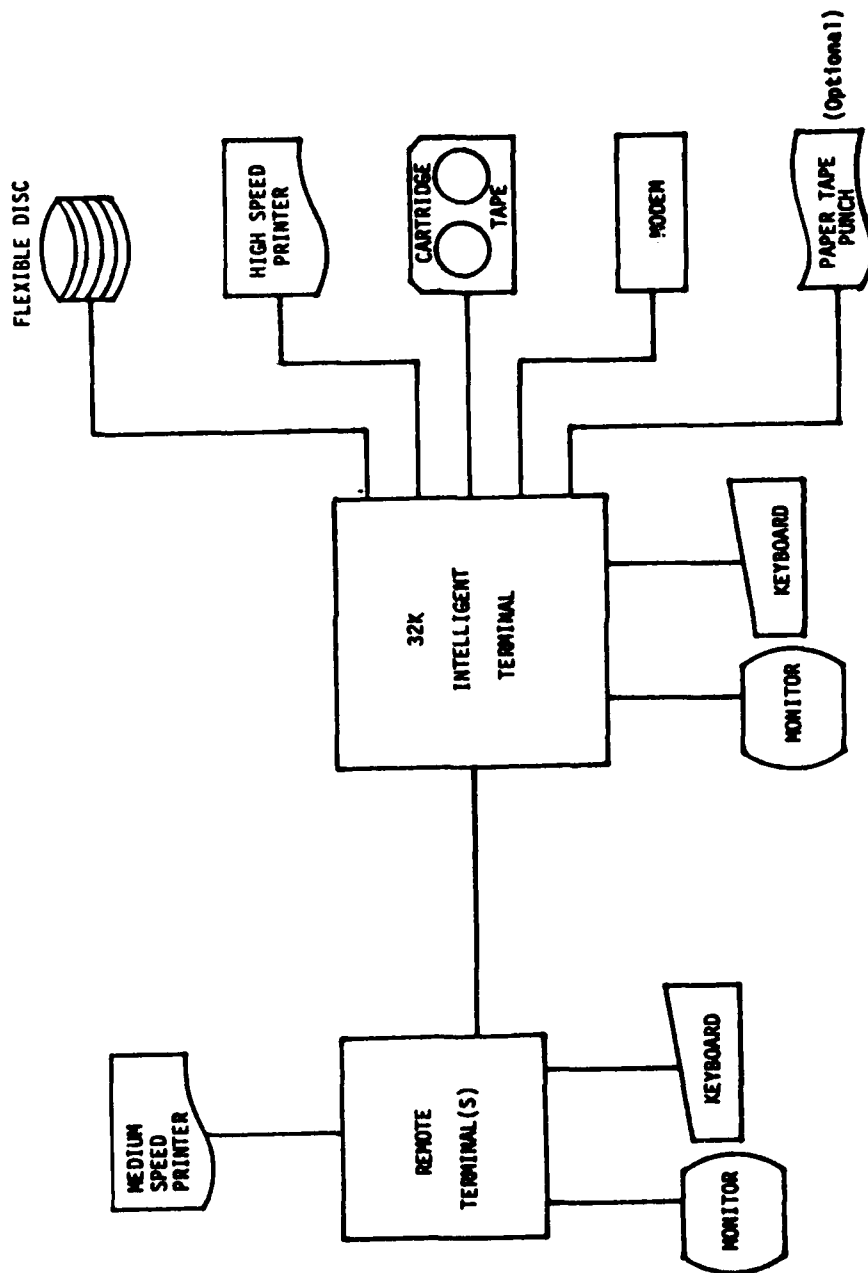   - One remote terminal with a medium speed printer

Figure 7

THE BASIC INTELLIGENT TERMINAL CONFIGURATION

4.2.1.4.2 Largest Class of Ships (CG)

The minimal shipboard hardware configuration recommended for the largest class of DEAS ships is as follows:

- Supply Department

    - One intelligent terminal
    - One high speed printer
    - Random access storage of at least 2.25 megabytes
    - Serial access storage of four cartridge tape drives
    - Communications equipment including a paper tape punch if necessary
    - Two remote terminals with medium speed printers, one of which would reside with the intelligent terminal in the supply support center

- Maintenance Department

    - One intelligent terminal
    - One high speed printer
    - Random access storage of at least .5 megabytes
    - Serial access storage of at least two cartridge tape drives
    - One remote terminal with a medium speed printer

- Administrative Area

    - One intelligent terminal
    - One high speed printer
    - Random access storage of at least .5 megabytes
    - Serial access storage of at least two cartridge tape drives
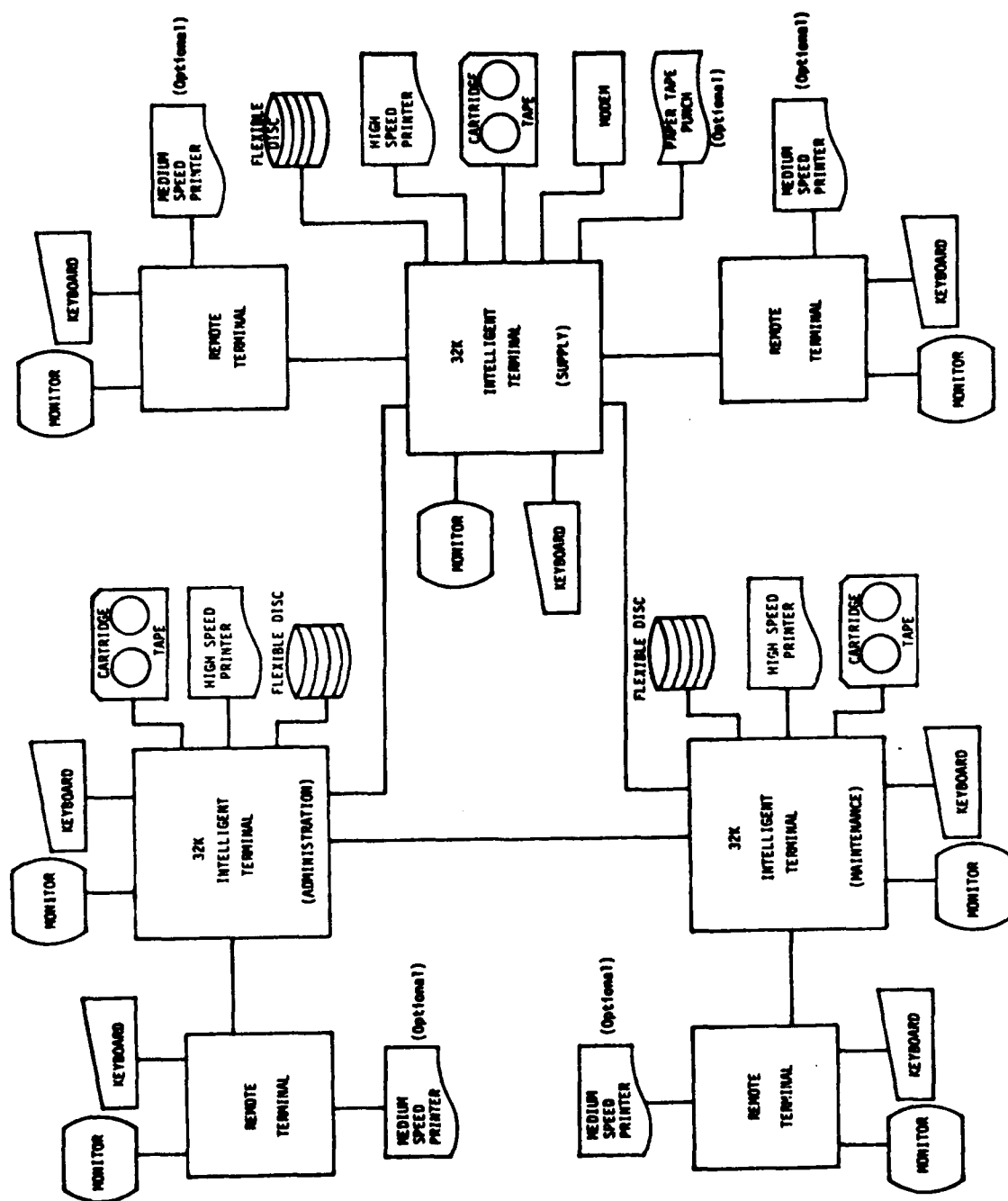   - One remote terminal with a medium speed printer

Figure 8 — A SOPHISTICATED SHIPBOARD NETWORK OF INTELLIGENT TERMINALS

It is assumed that an average size ship would have two intelligent terminals and several remote terminals to provide the processing power for the supply, maintenance and administrative departments. In this case, an added advantage is obtained because each system serves as a fail-soft back-up to the other. If one terminal is down, all the ship's applications could still continue to operate although in a degraded mode. Also, for this back-up to be effective all remote units should be switchable to any of the on-board intelligent units.

Each hardware component of the DEAS system should be modular in construction for storage and for quick and easy system maintenance. Software diagnostic routines provided for the hardware should be as simple as possible and usable by shipboard personnel with a minimum of training. Back-up hardware modules could easily be stocked.

4.2.2 Software Concept Recommendations

Several different areas of software will be defined within this section. They will comprise the total software requirements of an operational DEAS system.

4.2.2.1 System Software

Of critical import to DEAS will be the systems software on which it will be constructed. Without an effective suite of systems software the structure of DEAS could be seriously handicapped. The following are the software packages which are essential to developing an effective DEAS.

a. <u>Operating System</u> - the operating system should provide the following: simultaneous multi-task execution, simultaneous, multiple slave terminal access to distinct tasks, program linkage capability, support of a variety of I/O devices (disc, floppy disc, cassette tape, cartridge tape, paper tape reader/punch, card reader/punch, printer), user I/O access routines, file management functions, serial and random file access, telecommunications capability (110 - 9600 BPS).

b. <u>Programming Languages</u> - the system required for DEAS should have at least two languages: an assembly language and a higher level language. The higher level language may use either a direct compiler (on the system itself) or a cross-compiler (the latter most probably would provide a more powerful language capability). Higher level languages, or a reasonable subset of them, which can be considered for DEAS are COBOL, BASIC or PL-1. Non-standard higher level languages (i.e., vendor unique business languages) should be avoided if possible since long range portability and compatibility would be lost.

c. Data Entry - a data entry program generator should be available (such a program will save a great deal of programming). A data entry generator should accept a parameterized description of a data entry format (preferably through a tutorial, on-line sequence) and generate a screen display of the form required for data entry. The generator should provide the following data entry features:

- Validation by character or field

- Numeric, alphanumeric, range and special (multiple) value validation checks

- Predefinition of a field value (permanently for each form; at the beginning of each data session; or by automatic selection from a pre-specified data file)

- Automatic duplication of fields

- Designation of certain fields as required (i.e., system will not proceed until an entry is made)

- Ability to skip non-required fields

- Ability to reposition at any field and reenter the data for that field

- Automatic computation of data fields from other fields and predefined parameters

- Automatic editing of fields (system provides leading zeroes and trailing blanks to complete field length)

- Error lock on system (erroneous data entered locks keyboard until corrective procedures are taken)

- Any other features which will improve the ease of data entry and correction

- Use of own code for special features.

d. <u>Utilities</u> - the system selected for DEAS should have a full set of utility programs available to it. The most important of these is a sort/merge program. Other utilities of value are: copy routines for tape and disc (tape to tape, disc to disc, tape to disc, disc to tape), initialization and reorganization routines for tapes and discs, file conversion routines (random to serial and vice versa), program load and control functions if not provided for in the OS, communications (data transmittal) routines for communicating with various Navy computers (including the standard TTY conventions).

4.2.2.2 On-Line Systems

The On-Line Systems are those operations which would normally be conducted during the average workday. In general terms, they are data entry, record look-up, and file maintenance. Under current manual conditions performance of these functions would normally be randomly mixed throughout the day. Under an automated system the mixing of these functions should be equally natural and responsive to the demands of the shipboard environment. That is, the user (of the automated system) should be able to interrupt whatever function he is performing, if something of a higher priority comes up, switch to another function and then return to the original function without any dislocation or loss of data. The user procedures for such swapping should be absolutely simple and natural; furthermore, the mechanics of the interruption and restoration should be managed totally by the automated system and should be completely transparent to the user. The user should be totally unaware of the file handling and program swapping required to accomplish what for him is a perfectly natural thing to do; that is, stop his

work, do something else, and resume his work again. The system should also have extensive tutorial aids which the user can call up in the event he becomes confused or forgets his next steps.

The basic concept of the on-line systems is to provide the user with a simple, software framework within which he can perform any of his automated functions and with a minimum of understanding of the ADP operations required to provide him with this convenient access.

4.2.2.2 On-Line Systems

4.2.2.2.1 On-Line Data Entry

The application of data entry techniques to shipboard logistics departments is of prime importance because of the significant quantities of forms which must be prepared aboard ship either for shore transmittal reporting or for the functional purposes of the ship itself. The prime value of data entry is to digitize and validate data at the source. In this way the manual preparation of paper would be replaced by key entry of data. This procedure will provide the following key benefits:

- Immediate digitizing of data and its availability for computer processing

- Validation at the source so that errors are corrected at the ship and recycling of incorrect forms is eliminated

- Availability of this data for local shipboard use

- Reduction in data to be entered since much of the data can be extracted, automatically, from locally maintained files.

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The data entry procedures should be similar to manual recording of data in order to reduce the user's learning curve. It should be basically tutorial and self-checking so that the user learns as he uses and is notified when he makes errors. It should be flexible so that errors of omission, content, etc., can be easily correct without elaborate procedures. Basically the data entry procedures should be keyed to simplicity and should closely approximate manual methods. Finally, these procedures should require entry of as little data as possible, that is, only that variable data which is unique to each data entry operation; the repetitious, control data, which is essential for use by the recipients of the data and which must now be manually reproduced on each form, can easily and automatically be inserted from other local automated files. The last step in data entry is to allow the user to view his entire composite data form as a final verification of his data entry.

Although the bulk of the detailed data entry procedures will be defined by the data entry program generator, it is essential that the DEAS designers carefully organize the control setting in which the data entry will operate, the interfaces to other functions and data, and the design of the forms displays themselves in order to produce a highly user-oriented system.

Within the supply office, forms validation by data entry will be of immense value for improving the accuracy and reliability of data contained on the multitude of supply forms. Data entry will provide the supply clerk with an improved capability for forms completion using tutorial source data automation and CRT displays. This automated forms data will also provide the basis for automating all supply department operations: stock battery recordkeeping, requisitioning, OPTAR log maintenance, etc.

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Within the maintenance department data entry will provide a valid procedure for collecting, at a minimum, the 2-KILO data. A valid source for this data will have far-reaching effects within the Navy. Aboard ship it will lead, among other things, to an automated, local CSMP and automated work requests.

Similarly, data entry can be applied to the data capture problems of the administrative office. In particular, the use of OCR forms and the high error rates involved in that data would be eliminated. In digitized form such data would provide the groundwork for a shipboard personnel system.

4.2.2.2.2 On-Line File Search

Conventional wisdom when automating generally attempts to define a sweeping set of data reports to fit all occasions. However, such data is seldom organized the way problems and questions arise. Also, a comprehensive set of reports generates large volumes of paper. Aboard ship, paper storage and disposal is a serious problem.

Therefore, within DEAS a very critical feature within the on-line daily processing scheme is the availability of file search capabilities. Such a capability would provide for rapid access to the data which is stored in the ship's local files. With this type of data access the need to generate paper reports within an automated shipboard system is virtually eliminated and restricted to a few key and identifiable (and preferably short) reports. In addition, a good, rapid data access capability will eliminate the need to store the many forms and copies of forms which are currently filed for reference purposes. The only need which might require continued retention of

some forms would be as back-up in case of catastrophe or as an audit trail. However, even in those cases, automated lists could serve the same function and be considerably more compact.

A file search capability introduces the concept of providing answers to specific questions rather than trying to anticipate all questions in the fixed format of a report. Consequently, the file search technique is a more natural mode of operation. It is more in keeping with the manner in which answers are obtained, manually, when problems arise. File searching eliminates the artificial environment of fixed format reports. Because a file search capability would provide access to data using a variety of search criteria (depending upon which is most natural within a given situation), questions which arise can be quickly answered without reliance on the analyzing of lengthy paper reports.

In order for a file search module to be effective within the shipboard environment, it must be tutorial. Such a system must provide complex search capabilities in order to provide a useful service, however, this complexity must be transparent to the shipboard user. He should be led through the search in steps which are compatible with his normal operations and thought patterns. The procedure must be tutorial but not laborious since a continual user will not wish to wade through unending instructions once he has become familiar with the system. If lengthy explanations are made available, the user should be able to easily suppress them as he gains in experience. The search capability must also provide the user with flexibility so that he can access and retrieve data in the variety of ways which are compatible with normal, shipboard operations.

An excellent example of these concepts was provided in the DEAS Breadboard System. The supply department was provided with a search capability on the 1114 stock records and the outstanding requisition/status file. These two files are searchable by NIIN, part number, local part number, or document number. In this case, the flexibility to access data through any of these normal methods makes the difference between a system which can be of real use and one which inhibits access to data. It is important that the flexibility embodied in manual procedures be carried over into the automated retrieval of data. Automated retrieval must have the same capability for going directly to the needed data as is done in manual retrieval or it could become a hindrance to rapid data access.

Data retrieval will be of equal importance within the other logistics departments. Within the maintenance department, as a minimum, it will be necessary to access the stock battery file to determine parts availability, and it will also be necessary to access the maintenance job file to determine job status.

Similarly, the administrative department will wish to access personnel files on an ad hoc basis to identify needed skills, upcoming transfers, etc.

All the logistics information normally required to support operation of a Navy ship, will be available in the DEAS files. File search programs are a means of accessing that data within the normal problem-solving environment of the fleet. However, in order for search modules to be effective, they must be both tutorial and flexible.

4.2.2.2.3 On-Line File Update

Within the DEAS Breadboard System file updating was conducted as an off-shift operation. Consequently, data on the file (SIM/Outstanding Requisition) always reflected the previous day's status. For the operational DEAS it will be possible to combine data entry techniques with on-line updating in order to develop a truly responsive and current system. Using this type of technique, in all three logistics areas (supply, maintenance, administration), DEAS will provide accurate and reliable files of data for logistics support. The combination of data entry and file updating will take the bulk of the recordkeeping chores away from shipboard personnel. Tutorial and automatic sequences will do most of the work while providing a natural environment in which the sailor can perform his functions.

The following is an example, within the supply department, of how data entry and file update would be combined and coordinated to accomplish what are now routine, manual tasks.

EXAMPLE: Assume that the supply clerk is presented with a request for one dozen black pens, stock number 7520 009357136. The following sequence of events would occur.

SK: Initiate the data entry control function by depressing designated function keys.

DISPLAY: KEY IN THE NUMBER OF THE DESIRED SUPPLY ACTION FROM THIS TABLE

      1. 1250 ISSUE
      2. 1348 ORDER
      3. 1114 SIM UPDATE
          :
          :
          :
          :

SK: 1

```
DISPLAY:        KEY  IN  STOCK NUMBER
                  NSC         NIIN
                  ****      *********



                OR  PART NUMBER
                ****************


SK:             7520    009357136




DISPLAY:        KEY  IN  QUANTITY


SK:             1
```

After validating the clerk's responses, the system would search for and
locate the appropriate stock record and display the data shown on Figure 9.

```
DISPLAY:        STOCK IS ADEQUATE.
                DO YOU WISH TO ISSUE STOCK?

                    KEY    Y - YES
                           N - NO
```

The SK would quickly and visually verify the adequacy of the on-hand stock
level (32 dozen) and then give his response.

```
SK:      Y
```

Following this the system would print a chit sheet for issue containing stock
number, description, location, quantity and unit of issue. This paper would
be the actual release authorization document.

Figure 9 - Display of Matching 1114 Stock Record

1114 SIM STOCK RECORD

STOCK NUMBER	COG	M/C	SMIC	DESCRIPTION	U/I
7520 009357136	9Q			BLACK PEN	DZ

UNIT PRICE	APL/AEL	LOCATION	HIGH LIMIT	LOW LIMIT
1.24		A0014	60	30

A/L QTY	AT	E/R/C	BEG. MO. DEM
40	4	C	04/75

ON HAND QTY
32

MOVEMENTS YEAR-TO-DATE

DATE	5223	5203	5181	5160
QTY	00002	00001	00003	00001

NOTE: If a stock number match is not located, an appropriate message is displayed for the supply clerk. When the requested stock is not on-board, the clerk initiates the order program to produce a stock requisition.

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The system would automatically decrement the on-hand quantity of the displayed stock record and adjust the stock movements year-to-date to reflect the just completed issue. The following item shows that revised line of the display.

DISPLAY: ON HAND QTY   MOVEMENTS YEAR-TO-DATE

                       DATE   5289   5223   5203   5181   5160
                31   QTY   00001   00002   00001   00003   00001

The on-line system would then automatically transfer the supply clerk back to the data entry procedures so that he can complete the 1250 issue data. A partially completed 1250 would be displayed on the screen (this data would have been automatically excerpted from the 1114 stock record), see Figure 10.

At the bottom of the display the system would request the missing data items one by one.

DISPLAY: ENTER DEPT   *****
SK: E0120
DISPLAY: ENTER URGY   *
SK: C
DISPLAY: ENTER PROJ   ***
SK: EK5
DISPLAY: ENTER WC   ****
SK: OE01

As each data item is entered, the system would automatically place it in the appropriate position within the 1250 display. The completed form would appear as in Figure 11.

The 1250 issue data has been completed and is automatically stored for later transmission or mailing to the shore site. The supply clerk would now be ready for other duties.

Figure 10 - Incomplete 1250 Issue Form

| MATL. REQ. DATE 5289 | DEPT ***** | ISSUE X | T-I | USAGE | FILL | MART | LOC A0014 | REQN QTY. | REQ. NO. |

| MATL. ISS. DATE 5289 | RDD | URGY * | NIS | N/C | SIM NON-SIM X | INV 00031 | PROJ *** | SHIP HULL NO DD 944 |

| SOURCE C | COG 90 | STOCK NUMBER NSC 7520 NIIN 009357136 | DESCRIPTION BLACK PEN | U/I DZ | QUANTITY 00001 | UNIT PRICE 1.24 |

JOB CONTROL NO.   EIC   APL/AEL   FUND
                                                                    AC

UIC 52203   MC ****   JSN

COSAL SUPPORTED
YES X   NO   REMARKS

INSTRUCTIONS: ENTER DEPT *****

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Figure 11 - Complete 1250 Issue Form

MATL. REQ. DATE	DEPT	ISSUE	T-I	USAGE	FILL	MART	LOC	REQN QTY.	REQ. NO.
5289	EØ12Ø	X					AØØ14		

MATL. ISS. DATE	RDD	URGY	NIS	N/C	SIM	NON-SIM	INV	PROJ	SHIP HULL NO
5289		C				X	ØØØ31	EK5	DD 944

SOURCE	COG	STOCK NUMBER NSC NIIN		DESCRIPTION			U/I	QUANTITY	UNIT PRICE
C	9Q	.752Ø ØØ9357136		BLACK PEN			DZ	ØØØØ1	1.24

JOB CONTROL NO.   EIC   APL/AEL   FUND

UIC	WC	JSN
52203	OEØ1	

AC

COSAL SUPPORTED
YES X   NO   REMARKS

INSTRUCTIONS: ENTER WC OEØ1

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The actions which took place in this example highlight the following on-line procedures:

1) The supply department quickly and easily responds to a typical department request,

2) The stock files are searched and the stock record is quickly located,

3) The clerk is able to view the stock record and automatically update that record,

4) Next the clerk is able to complete the required issue form with minimum effort and time, and

5) The department issue information is automatically stored and later sent to the shore site.

These benefits will provide the supply department personnel and management with instant up to the minute asset visibility.

This example is representative of the types of procedures which can be developed for each of the shipboard departments. Such procedures can eliminate much recordkeeping effort and insure that records of each department are kept current and accurate through automatic procedures which prompt the human inputs as they are needed.

4.2.2.3 Recommended DEAS Data Files

The following section describes the files which are perceived as necessary for an operational DEAS system. This list is based on current experience and is not complete since additional analysis is required. In particular, for the maintenance and administrative departments, we do not pretend to have a complete list of files because much less analysis has been conducted, so far, in those areas than has been true of the supply area. This section provides a view as to the scope of files required for DEAS.

4.2.2.3.1 Supply Department On-line Files (Random Access Storage)

   a. <u>1114 SIM Stock Records</u> - the entire SIM battery would be placed
on one high-speed storage device, sequenced by stock number. Record changes
(adds, deletes, updates) would be validated through data entry routines and
immediately posted to the SIM file. Additional logic would include adjust-
ments to on-hand quantity, updating stock data from 1348-1 receipt forms,
computing re-order points, and posting usage data per stock item. Other
logic as necessary should be accorded. Allowance Parts List (APL) and other
file information provided by FMSO/FAGLANT are prepared on an individual ship
basis and automatically updated by ship's intelligent terminal.

   b. <u>1348 Outstanding File</u> - 1348 Requisitions and Status records would
be located on one or two small high-speed storage devices, sequenced by
document number and cross-referenced by stock number. Updates to the file
include adds, deletes and listing the latest status by last date referenced
first.

   c. <u>Non-SIM Stock Records</u> - where high-speed storage is available, the
most active Non-SIM records (10-15 percent of the file) would be placed on-line.
Maintaining a small percentage of Non-SIM records on-line would provide the
supply department with instant access to 80 percent of their Non-SIM record
searches and updates. The Non-SIM interactive file is updated in the same
manner as the SIM stock records.

4.2.2.3.2 3-M Maintenance System - On-line Files (Random Access Storage)

a. Ship Repair Requirements File - maintenance jobs listed from 2-KILO
records and local ship's force repair duties. The maintenance jobs also
reference 1250 issues from stock and 1348 requisitions outstanding (CASREPTS,
DTO's, etc.). Update logic would include adds, deletes, manhours worked,
etc., and would provide instant job information for department heads,
commanding officer, etc.

b. Planned Maintenance File - to list, periodically, all planned main-
tenance tasks for ship's force. Planned maintenance files for all ships
would be maintained and controlled by the Maintenance Data Collection
Subsystem (MDCS) on shore. The local ship's records would be sent, on a
periodic basis, to the ship via transmission lines or compatible medium.
The local ship will continue to provide daily updates to the file in order
to report maintenance status to the management staff (department head, C.O.).

4.2.2.3.3 Administrative Department - On-line Files (Random Access Storage)

Personnel Record File - to contain pertinent personnel data for admin-
istrative use. Update capabilities are provided to allow for changes to a
record indicating latest status (training, leave data, etc.) of ship's
personnel.

4.2.2.3.4 Supply Department - Current Files (Serial Access Storage)

a. 1114 Non-SIM Stock Records - inventory of Non-SIM stock records contained on serial storage device. Those records (85-90 percent) not located on random storage.

b. Financial Record File - necessary financial record information from 1348 requisitions to produce ship's OPTAR Log, 10 and 30 day financial reports, etc., contained on serial access storage devices. Update procedures will include: 1) processing 1348-1 receipt data, 2) accumulating fiscal monies by department, 3) processing financial reconciliation statements, 4) maintaining budget balances, and 5) providing other logic as mandated.

c. Historical Demand File - not/carried stock data posted to file, stored on serial access storage device. Logic considerations should include report on use and possible storage of stock items exceeding one or two occurrences per year. Also weight and volume of stock item prior to storage should be taken into account.

d. 1348 Completed File - serial storage of completed 1348 requisitions. Referenced for historical or fact-finding purposes. Logic should provide statistical analysis on usage, shipment and procurement delays, etc.

e. Ship Stores File - stored on serial access device, contains budget and inventory information on retail items sold on-board ship. Key information to be obtained would be: 1) usage and re-order point, and 2) listing of available retail items not stocked.

f. Food Service File - an inventory of ship's food, budget information, where applicable, located on serial storage devices. Programmed logic to include: 1) storage accessibility, 2) re-order point, 3) cost analysis, 4) menu preparation, 5) shelf life, etc.

4.2.2.4 Additional Programs

4.2.2.4.1 Supply Department

a. 1348 Automatic Order Program - to produce requisitions for stock replenishment, DTO, CASREPT and SERVMART walk-through conditions. Suggested options to incorporate are ordering: individual items, all needed stock replenishment items, all items in chosen price range, or all items within a given total dollar value. Program should give default values for data fields which are user changeable. This should be a highly tutorial and interactive program which allows the Supply Officer to review eligible re-order items, evaluate the various combinations which are affordable, and on his final selection generate automated 1348's.

b. Generalized Report Program - to give the supply department an option oriented program for producing various reports from supply files. Useful reports for the supply department would include: 1) requisition and status reports by date, priority and work center code, 2) stock off-load-list by cost, weight and volume, and 3) list of possible stock record changes to SIM file or to Non-SIM file.

c. **Communications Program** - to provide the supply system transmittal programs to send ship's data (1250 issues, 1348 requisitions, finance records, etc.) to shore computers. Also the transmittal package should allow the ship's supply department to receive status messages from shore computers and provide a link to the SERVMART data base for needed stock supplies.

4.2.2.4.1 3-M Maintenance System

Generalized Report Program - required for ship's management staff. Logic is necessary to produce a local ship's Current Ship Maintenance Project (CSMP) by work center code, priority, insurv number, etc., and to generate a local Automated Work Request (AWR).

Communications Program - to send 2-KILO information to shore based 3-M system and receive data from shore containing planned maintenance requirements.

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